SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MARCH 1904.

GENERAL PHYSICS.

464. *Elasticity of Silk.* **F. Beaulard.** (Journ. de Physique, 2. pp. 785–795, Nov., 1903.)—For silk, Lamé's parameters $\mu = 1{\cdot}268 \times 10^{10}$ and $\lambda = -1{\cdot}864 \times 10^{10}$; Poisson's coefficient $\sigma = 1{\cdot}563$; Young's modulus, average, $E = 6{\cdot}50 \times 10^{10}$; lateral contraction $\beta = 2{\cdot}393 \times 10^{-11}$; coefficient of tenacity $T = 1{\cdot}141 \times 10^{8}$, or for simple fibres (two filaments) $2{\cdot}85 \times 10^{8}$. Young's modulus diminishes rapidly, and the lengthening slows off as the load is increased. The elasticity is perfect, and there is no hysteresis; but the silk is anisotropic. [See also Abstract No. 375 (1903).] A. D.

465. *Applications of the Varenne Chronostiliscope.* **E. Varenne** and **L. Godefroy.** (Comptes Rendus, 138. pp. 79–82, Jan. 11, 1904.)—The chronostiliscope consists of a perpendicular glass tube of about 30 c.c. capacity, on which two fixed marks are engraved, and which is closed at both ends by corks. Through the lower cork passes a capillary tube, and through the upper a wider tube, the lower end of which reaches down to below the lower mark on the outer tube. This ensures an outflow under a constant pressure, on the principle of the Mariotte bottle. The larger tube is filled with liquid to above the higher mark. With this apparatus one can determine the variations in the coefficient of outflow, and also study the viscosity and surface tension of different liquids. The latter is determined by counting the number of drops which fall during a period of 60 sec. A. F.

466. *Theory of Diffusion.* II. **M. Thiesen.** (Deutsch. Phys. Gesell., Verh. 5. 6. pp. 130–139, March 30, 1903.)—The author develops his theory [see Abstract No. 615 (1903)] for the case of porous substances, and applies it particularly to the experiments of Hansemann on the diffusion of oxygen and hydrogen through gypsum plugs. Theory and experiment do not agree very well, which the author thinks may be due to actual flowing of the gas through cracks or fissures in the gypsum. F. G. D.

467. *Application of Mechanical Principles to Motions under Friction, with an Addendum on the Energieumsatz in Mechanics.* **G. Zemplén.** (Ann. d. Physik, 12. 2. pp. 356–372, Aug., 1903.)—The mechanical principles may be divided into two groups. Group D, the principles of D'Alembert and Hamilton, have the form—

$$D = \sum_{i=1}^{i=n} (m_i x_i'' - X_i)\partial x_i = 0,$$

with corresponding expressions for y and z. Group G, the Gauss principle—

$$G = \sum_{i=1}^{i=n} (m_i x_i'' - X_i)\partial x_i'' + \&c. = 0,$$

in which under the variations ∂x_i and $\partial x_i''$ are understood any variations consistent with the conditions of the system as regards constraints, &c. Group G includes Gauss' principle of least constraint. This, as usually hitherto expressed, asserts that, if a material system moving from rest under given impulses, be subject to constraints, its actual motion is the motion which if free it would take, combined with another required to satisfy the constraints; and the kinetic energy of this latter motion is less than that of any other motion which would satisfy the constraints. This also is easily extended from impulsive to continuous motion. The author supposes the system to move from an initial position x, y, z, during the short time τ, and comparing its actual position $\bar{x}, \bar{y}, \bar{z}$ at the end of that time, with that of an unconstrained system ξ, η, ζ, he defines the "constant" in Gauss' principle to be—

$$Z = \sum_{i=1}^{i=n} (\overline{\xi - x}^2 + \overline{\eta - y}^2 + \overline{\zeta - z}^2)$$

And he proceeds to the limit, making τ infinitely small, and finds Z to be a minimum. The theorem established is as follows: "Given a system of material points, under forces depending on the positions and the time, and subject to conditions expressible by equations or inequations, and accompanied by friction, and the whole motion taking place in a resisting medium." Then he gives the differential equation of the motion, assuming Gauss' principle. The paper ends with a note on Januschke's treatment of the Ostwald principle of maximum Energieumsatz, in which the author replies to a former paper by Januschke. [See also next Abstract.] S. H. B.

468. *On the Transformation of Energy in Mechanics—a Correction.* **H. Januschke.** (Ann. d. Physik, 12. 5. pp. 1175–1176, Nov., 1903.)—This relates to a former paper, in which the author explained the Ostwald principle of transformation of energy as applied to the motion of a particle under central force. So applied the Ostwald principle is in fact Bertrand's theorem slightly extended. Bertrand proved that a material system set in motion from rest under given impulses takes less kinetic energy if constrained than if free, so that under given constraints the energy taken is a maximum. That is easily extended to continuous forces. For instance, a particle falling under the action of gravity increases its kinetic energy per unit of time more, and diminishes its potential less, if free than if on an inclined plane. The author shows that if, moving in a plane under central force, the resolved part of that force normal to the motion is equal and opposite to the centrifugal force, so the tangential component produces or destroys per unit of time the maximum kinetic energy of motion in that direction. This change from kinetic to potential energy or *vice versâ* is the "Energieumsatz." In the present note he desires to correct a criticism made by G. Zemplén on the the former paper. [See preceding Abstract.] S. H. B.

469. *Efforts Developed in the Impact of a Ram on an Eprouvette.* **A. Pérot.** (Comptes Rendus, 137. pp. 1044–1046, Dec. 14, 1903.)—The eprouvette is held in a sort of vice movable about a horizontal axis, the vice being carried by a powerful spring. A pencil of parallel rays falls on a mirror carried by the axis, and thereafter is made to strike a photographic plate carried by the head of the ram, which plate is exposed at the instant of impact. Development of the plate gives a curve whose ordinates are the displacements of the ram, and whose abscissæ are proportional to the deformations of the spring, and consequently to the efforts. W. S.

470. *Periodicity of Solar, Meteorological, and Earth-Magnetic Phenomena, explained by the Dispersion of Light.* **W. H. Julius.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 270–302, Nov. 25, 1903. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Oct. 31, 1903.)—The author believes that the commonly held views as to the thickness of concentric layers in the solar atmosphere, the velocity of prominences, the displacement of matter on sun-spots, the dissociation of elements in the sun, &c., are untenable, because based on the erroneous assumption that the objects are situated in the directions in which we see them. In his opinion, the sun-rays reach us in curvilinear paths; the sun is probably an unconfined gaseous mass which has practically remained in a stationary condition in the memory of man; in structure the sun is lamellar, and, at places where whirls are formed, tubular. The prolongations of some of the surfaces of discontinuity (Emden, Helmholtz) strike the earth; if we look along the axis of a whirl, we see a dark spot. The author has repeated Ebert's experiments imitating sun-spots, reversals and displacements of lines, by dispersing the light of the electric arc in flames of burning sodium. If we accept the value 25·929 days for the synodical solar day—the estimates differ considerably—for a series of points on the equator of the "average rotating sun," the projection of the earth on the sun will describe a spiral in a little more than eleven years. Thus the eleven-years' period may be due to a periodical variation in the position of the earth with regard to the sun, and further to a continuous change—not necessarily periodical—in the solar surfaces of discontinuity. He discusses these views and the effect of the movement of the earth through the irregular field of solar radiation with regard to sun-spots, prominences, faculæ, periodicity in the fluctuations of illumination, annual variation in the diurnal inequality of terrestrial magnetism, magnetic disturbance, meteorological phenomena, and daily barometric variation, referring to Arrhenius, Chree, Cortie, Bigelow, Lockyer, Nordmann, and others. It is noteworthy that the cosmical influence does not affect the illuminated hemisphere uniformly, although the solar parallax is only 8·8″. The surfaces of discontinuity move so rapidly over the earth, that magnetic disturbances are almost simultaneous over the hemisphere; the effects are almost identical at spots lying close together, but may be of opposite directions in places far apart. H. B.

471. *Calcium and Hydrogen Flocculi.* **G. E. Hale and F. Ellerman.** (Astrophys. Journ. 19. pp. 41–52, Jan., 1904.)—Results obtained with the

Rumford 40-in. refractor at Yerkes Observatory; these are much superior to those formerly obtained with the Kenwood instrument. The authors distinguish between faculæ—elevated regions of the photosphere capable of being seen with the eye or on direct photographs and having a continuous spectrum—and flocculi, clouds of vapour at a higher level, visible only on the spectroheliograph. By setting the second slit of the instrument on different portions of the dark lines, photographs have been obtained at different elevations above the photosphere. With calcium, the H and K lines appear brightest in the intermediate layers, but the authors suggest this may be due to chemical or electrical effects, and not necessarily to an abnormal temperature. Four photographs show the same region at four different elevations, the positions of the slit on the continuous spectrum being $\lambda = 3924$, 3929, 3932, 3933·8. From these and other photographs given, the calcium flocculi appear to be made up of a series of columns which expand and overhang laterally at higher levels. In studying the hydrogen lines, a grating was used in conjunction with the prisms, to give greater dispersion. The most important deduction from the investigation is that the temperature of the hydrogen gas appears to be so near the neutral point that the flocculus from it may be dark over almost the same region where the calcium flocculus is bright. Reference is made to corresponding dark calcium flocculi.

H. F. H.

472. *Recent Spectrographic Observations of Novæ with the Crossley Reflector.* **C. D. Perrine.** (Astrophys. Journ. 19. pp. 80–83, Jan., 1904. From Lick Observatory Bulletin No. 48.)—In Nova Aurigæ the nebula line λ 501 has disappeared since 1901, and certain others show a reduction in intensity. Nova Persei shows λ 501 unchanged, but $\lambda\lambda$ 339 and 346 have almost vanished. The line λ 501 has increased its intensity in Nova Geminorum, and a new line λ 346 sprung into existence, blotting out λ 350. The author suggests that the spectra of these Novæ are going through definite cycles which occupy but a few years, and that eventually they will become continuous spectra without bright lines. [See also Abstracts Nos. 240, 241 (1904), and next Abstract.] H. F. H.

473. *Spectrum of Nova Geminorum.* **H. D. Curtis.** (Astrophys. Journ. 19. p. 83, Jan., 1904. From Lick Observatory Bulletin, No. 48.)—Visual observations made with the 36-inch refractor. The most conspicuous line in August, 1903, was λ 5007, which had only begun to appear in April. Most of the light appears confined to lines, and there is little continuous spectrum. The change to the nebular type seems complete. [See also Abstracts Nos. 240 and 241 (1904).] H. F. H.

REFERENCES.

474. *Determination of the Direction of a Projectile's Axis at the End of its Path.* **F. Neesen.** (Deutsch. Phys. Gesell., Verh. 5. 5. pp. 110–112, March 15, 1903.)—The method proposed is a slight modification of the photographic arrangement given by the author for determining the velocity of the projectile. [See Abstract No. 694 (1903).] W. S.

475. *Stellar Photography.* **A. Riccò.** (Accad. Lincei, Atti, 12. pp. 25–30, Jan. 18, 1903.)—This is a summary of work done at the Catania Star-charting Observatory. The work has now reached the stage of cataloguing. A. D.

476. *Surface-tension at the Boundary of Aqueous Colloid-solutions of Different Concentration.* **G. Quincke.** (Ann. d. Physik, 9. 4. pp. 793–836, Nov.; 9. 5. pp. 969–1045, Dec., 1902; 10. 3. pp. 478–521, Feb.; 10. 4. pp. 673–703, March; and 11. 1. pp. 54–95, April, 1903.)—This is a continuation of the work previously described [see Abstract No. 380 (1903)]; the conclusions are summarised in a series of thirty-four statements. T. M. L.

477. *Earth-pressure at Curved Surfaces of Slip.* **F. Kötter.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 12. pp. 229–233, Feb. 26, 1903.)—This is a mathematical paper. The pressure at the surface of slip being known, the pressure of the earth on retaining walls can be found by the results given. W. S.

478. *Lunar Eclipse of April* 11, 1903. **Montangerand.** (Comptes Rendus, 136. pp. 950–952, April 20, 1903.)—The results of some photographic observations of the moon during this eclipse taken at the Toulouse Observatory. E. C. C. B.

479. *Lunar Eclipse of April* 11, 1903. **P. Puiseux.** (Comptes Rendus, 136. pp. 988–989, April 27, 1903.)—Some photographic observations of the moon's disc during the eclipse. E. C. C. B.

480. *Lunar Eclipse of April* 11, 1903. **A. Kannapell.** (Comptes Rendus, 136. pp. 989–990, April 27, 1903.)—Some notes on the appearance of the moon during the eclipse. E. C. C. B.

481. *Stationary Meteor Radiants.* **B. L. Newkirk.** (Phys. Zeitschr. 4. pp. 408–410, April 15, 1903.)—A discussion of the phenomena of meteor radiants. E. C. C. B.

482. *Statistics of the Asteroids.* **O. Callandreau.** (Comptes Rendus, 136. pp. 937–939, April 20, 1903.)—The author in this paper gives a table showing the distribution of the elements of the asteroids when the aphelion distance is taken as argument. E. C. C. B.

483. *Transparency of Comet* 1902 *b.* **E. C. Pickering.** (Astrophys. Journ. 17. pp. 245–246, April, 1903. From Harvard College Observatory Circular, No. 68.)—From a series of photometric observations of the star + 21°·3483, of magnitude 7·12 through this comet, it was found that the absorption of light due to the comet was insensible, and did not exceed one or two hundredths of a magnitude. E. C. C. B.

484. *Diagrams Illustrating the Correction of Star Places for Precession.* **L. Weinek.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 571–577, April–June, 1903.)—The well-known formulæ are derived by the aid of diagrams, the absence of which is, in the author's opinion, a great drawback in text-books. A. E.

485. *Additional Stars of the Orion Type with Varying Radial Velocities.* **E. B. Frost** and **W. S. Adams.** (Astrophys. Journ. 17. pp. 246–247, April, 1903.)—Two new stars whose radial velocities vary were found in τ Tauri and ψ Orionis; the former shows a total range in velocity of 75 km., and the latter 270 km., but these measurements are only preliminary. The star η Hydræ also appears to have a variable velocity, but the diffuseness of the lines makes accurate measurements difficult. E. C. C. B.

486. *Meteorological Observations at St. Maurice.* **R. Gautier.** (Archives des Sciences, 15. pp. 327–334, March, 1903.)—Deals with the observations made during the four months August to November (1902) inclusive.

487. *Meteorological Observations at Moscow in* 1902. **E. Leyst.** (Soc. Imp. Nat. Moscou, Bull. 4. pp. 532-567, 1902.)—The observations [see Abstract No. 967 (1903)] have been continued by Speransky, Pokrowsky, and Jakowlew. Among the new instruments are a Campbell-Fuess sunshine recorder, a Hellmann-Fuess pluviograph, an Exner electroscope with a benzine lamp collector, and a dispersion apparatus of Elster-Geitel. The winter 1901-1902 was mild, the rest of the year, April to December, cold. H. B.

488. *Relative Humidity at Tarnopol.* **L. Satke.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 211-241, Jan.-March, 1903.)—The author tabulates and discusses the results of observations, conducted at Tarnopol (Austrian Galicia) in the period 1895 to 1900, on the diurnal period and variability of the humidity, with the aid of a Richard hygrometer and a psychrometer; he prefers the former instrument. H. B.

489. *Semidiurnal Tides in the Northern Indian Ocean.* **R. A. Harris.** (Monthly Weather Rev. 31. pp. 127-133, March, 1903.)—With the aid of the Tide Tables of the British Admiralty and of the United States Coast and Geodetic Survey, the author compiles a chart of cotidal lines, giving the average Greenwich lunar time of high water over the northern portion of the Indian Ocean, extending from Australia north-west over to the Somali and Arabian coasts. H. B.

490. *Solar Observations at the Lyons Observatory during the First Three Months of* 1903. **J. Guillaume.** (Comptes Rendus, 136. pp. 994-995, April 27, 1903.)—Records of observations made during the first quarter of 1903. [See also Abstract No. 706 (1903).]

491. *Sun-spots and Magnetic Storm of October* 31, 1903. **F. Quénisset.** (Comptes Rendus, 137. pp. 747-748, Nov. 9, 1903.)—The sun-spots were, according to photographs taken at Nanterre, only of one-third the size of the sun-spots of October 11, which caused hardly any magnetic perturbation; but the faculæ were of unusual development. H. B.

492. *Second International Seismological Conference.* **F. de Montessus de Ballore.** (Revue Scientif. 20. pp. 609-614, Nov. 14, 1903.)—The second conference met, like the first, at Strassburg on July 24-28, 1903, and was attended by a hundred delegates and guests. H. B.

493. *Earthquake of March* 15, 1903. **C. F. Marvin.** (Monthly Weather Rev. 31. pp. 125-127, March, 1903.)—A feeble earthquake was recorded at Washington, D.C., Toronto, and Victoria, B.C., and also at Baltimore, Md.; the latter record is not reproduced. The three last-mentioned stations are fitted with Milne seismographs. The strong waves travelled at the rate of 3·2 km. per sec. H. B.

494. *Sun-heat Measurement.* **C. Chistoni.** (Accad. Lincei, Atti, 12. pp. 258-263, April 5, 1903.)—The author measured the quantity of heat radiated by the sun on to a surface of 1 sq. cm., having an absorbing power of unity, 146 times from July 21 till September 25, 1899, at Sestola and Mount Cimone (Modena), at the same time observing the height of the sun, the barometer reading, the temperature, the elastic force of the atmospheric steam, and the relative humidity of the atmosphere. A. Fa.

495. *Volcanic Dust, Bishop's Ring, and Atmospheric Absorption.* **T. W. Backhouse.** (Nature, 69. p. 81, Nov. 26, 1903.)—Bishop's rings have never been quite absent in Europe since 1883, and have for some months now been conspicuous in full daylight. The author refers to Rotch and Langley, and connects the increased absorption with the volcanic dust. H. B.

496. *The 27-day Period in Auroræ and Sun-spots.* **H. H. Clayton.** (Science, 18. p. 632, Nov. 13, 1903.)—Auroræ, generally accompanied by rains, were observed in New England on July 25 and 27, and again in August, September, and October, at intervals of 27 days. Another group of auroræ started on August 26, and was observed again on September 21. These displays seem to have preceded sun-spot activity, and the period may be connected with the sun's rotation period of 27 days. The author favours Arrhenius' theory of auroræ. H. B.

497. *Simultaneous Solar and Terrestrial Changes.* **N. Lockyer.** (Science, 18. pp. 611–623, Nov. 13, 1903. Report read before International Committee, Southport, 1903.)—Historical sketch of the inter-relation between solar and terrestrial phenomena with special regard to the work done in Great Britain and India, and by the author and W. J. S. Lockyer. [See Abstracts Nos. 198, 291, and 1459 (1903).] H. B.

498. *The Eruptions on Martinique.* **A. Lacroix.** (Comptes Rendus, 136. pp. 871–876, April 6, 1903.)—General remarks [see also Abstract No. 995 (1903)] particularly on the growth, in the crater, of a cone, reminding the author of the Dômes of the Auvergne, and on the destructive vapour clouds. H. B.

499. *The Eruptions on Martinique.* **A. Lacroix.** (Revue Scientif. 20. pp. 674–686, Nov. 28, 1903. Conférence faite à la Société des Amis des Sciences, June 9 and July 7.)—[See Abstracts Nos. 281, 702, 705, and 995 (1903).] H. B.

500. *The Mont Pelée Obelisk.* **I. C. Russell.** (Science, 18. pp. 792–795, Dec. 18, 1903.)—The solid lava in the throat of Mont Pelée was, the author states, forced upward in a massive condition until it stood at one time 1,600 ft. higher than the rim of the crater from which it protruded. H. B.

501. *Lunar Eclipse of October 6, 1903.* **E. Bordage** and **A. Garsault.** (Comptes Rendus, 137. pp. 897–898, Nov. 30, 1903.)—The observers had a cloudy sky on the Île de la Réunion. H. B.

502. *Leonid Meteor Shower.* **W. H. Milligan** and **W. E. Rolston.** (Nature, 69. p. 127, Dec. 10, 1903.)—Milligan observed an intense shower in the early morning of November 16, at Holywood, in Co. Down. Rolston, at South Kensington, counted more than fifty leonids at the same time, and he confirms Henry as to there being apparently two radiants. H. B.

503. *Ferguson's Podograph.* (Zeitschr. Instrumentenk. 23. pp. 277–280, Sept.; Revue de l'Él., Berne, 12. pp. 189–190, Dec. 31, 1903.) — A description of the podograph, an instrument with which the observer walks along, say, a road, keeping a guide-line coincident with a magnetic needle by adjusting screw-heads as he goes; the instrument then records the length, direction, and windings of the road to a scale of 1 to 10,000, 12,500, 25,000, or 50,000, as may be desired. The error has been found not to exceed 150 m. in 20 km.: and this is accurate enough for many military and exploring purposes. A. D.

504. *Recording Apparatus for Measuring the Difference of Pressure between Points in a Moving Liquid.* **M. A. Mesnager.** (Comptes Rendus, 138. pp. 75–76, Jan. 11, 1904.)—The difference in pressure causes mercury to flow from one vessel to a second, which is hung on a spring. The length of the spring varies, and the variation in length is recorded by a suitable instrument. W. S.

505. *The New Cosmical Meteorology.* **F. H. Bigelow.** (Science, 19. pp. 30–34, Jan. 1, 1904.)—The author discusses the circulation of the sun and the solar-terrestrial synchronism. H. B.

LIGHT.

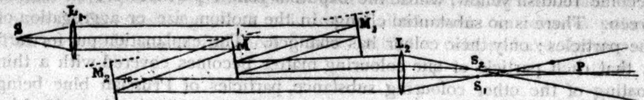
506. *New Spectrum Colour-mixing Apparatus.* **L. Asher.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. pp. 326–329, Oct. 15, 1903.)—An apparatus is described in which two beams from an Auer lamp pass, after reflection through four slits, and are incident in parallel rays on a Thorpe transmission grating. The combined beam then passes through an objective and a bi-prism to the eyepiece, and various mixtures of spectrum colours are obtained by arrangement of the four slits, which are arranged two above and two below. The spectra are separated by the bi-prism, the edge of which is horizontal. Two good diagrams of the instrument are given. G. E. A.

507. *Improved Form of König's Spectrophotometer.* **F. F. Martens** and **F. Grünbaum.** (Ann. d. Physik, 12. 5. pp. 984–1003, Nov., 1903.)—In this instrument the two beams of light pass through two adjacent slits and then through a collimating lens and a single flint prism; they next pass through a Wollaston calcite prism and then a bi-prism, after which they are brought to a focus by a telescope lens. In this way four images, two polarised in the horizontal plane and two in the vertical plane, are formed of each slit; the eyepiece, however, only receives two images, one from each slit, which are polarised at right angles to one another, and which partially overlap. By means of a nicol prism the relative intensity of these can be altered and photometric comparison thus made between the light from two sources. Full details of the experimental method, together with the elimination of errors, are given in the paper. E. C. C. B.

508. *Absorption Measurements with Coloured Aqueous Solutions.* **F. Grünbaum.** (Ann. d. Physik, 12. 5. pp. 1004–1011, Nov., 1903.)—The substances used were copper sulphate, the two chromates of potassium and dinitro-α-naphthol monosulphonic acid. Solutions in water were made of these, and their absorptive power compared with water in a König spectrophotometer. Four different thicknesses were employed, 25, 12, 5, and 2 cm., and the results expressed in terms of the extinction coefficient, which is defined as that thickness necessary to diminish the intensity of the light during transmission to 1/10th its initial value. Curves are given of the results, showing the connection between the extinction coefficient and the wave-length. [See also preceding Abstract.] E. C. C. B.

509. *"Star" Continuous Photo-Printing Machines.* **L. F. Rondinella.** (Eng. News, 50. pp. 507–508, Dec. 3, 1903.)—This printing machine is made in three sizes for producing prints of any length up to 70 ft., with maximum width of 30, 42, and 54 in. The casing holds the materials before, during, and after printing, and all of the mechanism except the 1/20-h.p. electric motor. By making the opening of the lid narrow or wide, the time of exposure may be regulated for sun or electric printing, the geared drum, on which the sensitive material is rolled, giving the necessary continuous motion. G. E. A.

510. *Reflection Refractometer.* **T. Vautier.** (Journ. de Physique, 2. pp. 888–899, Dec., 1903.)—The object of the apparatus described is to completely separate the two systems of interfering waves over a considerable length of path. This is done by means of a system of three mirrors, M_2, M, M_1, the arrangement of which may be seen from the diagram. The instrument is capable of showing, in air at atmospheric pressure, a displacement of the bands equal to the width of a band when the density of the air changes by 1/10,000. For this the optical path requires to be 13 m. long. G. E. A.



511. *Light, Colour, and Colour-Tinted Glasses.* **J. W. Walmsley.** (Dioptric Rev. 7. pp. 346–350, Aug.; 396–399, Sept.-Oct.; and pp. 495–497, Nov., 1903. The New York "Optical Journal.")—Wearers of tinted spectacles are recommended, in general, to adopt smoked glasses in preference to coloured. Continued exposure to monochromatic light tends to derange the organs of colour perception—a fact which [apart from other reasons] renders the use of coloured spectacles for aiding defective colour-vision out of the question. Men employed in the manufacture of photographic plates, who spend many hours a day working by red light, complain of irritation of their eyes. Quality of the glass as regards transmission of chemical rays need play only a secondary part in choice of lenses. Acquired colour-blindness in the majority of cases is due to disturbance of cerebral centres with accompanying lesion in the optic nerve. Retinal or chorio-retinal diseases produce a reduced vision without particular loss in colour, while disease of the optic nerve produces more or less colour-blindness, always accompanied, however, by impaired form vision. A. E.

512. *Glass Transparent to Ultra-violet.* **E. Zschimmer.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. p. 312, Oct. 15, 1903.)—The best kinds of glass hitherto known absorb, in 1 cm. thickness, 100 per cent. intensity of the rays of wave-length 305 $\mu\mu$ which penetrate the surface. A process has been discovered by means of which glass can be produced which will transmit 50 per cent. of the above rays through 1 cm., or 50 per cent. of the rays $\lambda = 288\,\mu\mu$ through 1 mm. Astro-photographic experiments prove that objectives made of this glass show more stars and give finer details, and a filter for short waves has been produced, which absorbs strongly from red to blue, but is transparent to blue, violet, and ultra-violet to about $\lambda = 280\,\mu\mu$ for 1 mm. thickness. G. E. A

513. *Ultra-microscopic Investigation of Mixed Pigments.* **E. Raehlmann.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. pp. 330–339, Oct. 15, 1903.)—The two working substances, Prussian blue and naphthol-yellow, are distinguished by the especial purity of their smallest constituents. Zsigmondy's method [see Abstract No. 1169 (1903)] is employed along with a microscope which is capable of distinguishing a magnitude of 0·000001 mm. In this instrument the smallest particles of Prussian blue in water appear violet-red, those of naphthol-yellow, brass-yellow, and these particles are in continual motion

each colouring matter having a distinctive motion, the nature of which depends on the size of the particles and the concentration. When the two colours are mixed to form a green-coloured liquid, the particles now seen under the microscope are quite different; the Prussian-blue particles have become reddish yellow, whilst the naphthol-yellow particles are an intense green. There is no substantial change in the motion, size, or aggregation of the particles; only their colour has changed. The explanation put forward is that each particle of one colouring matter becomes covered with a thin coating of the other colouring substance, particles of Prussian blue being coated with naphthol-yellow and *vice versâ*. This explanation is verified by spectroscopical examination of the three colours. In explaining why one colour is deposited on the other, the author considers it extremely probable that very small particles can migrate and group themselves round the large particles, the process being the same as that which, according to Thomson and Townsend, takes place when mist and cloud are formed. Next, assuming that the two kinds of particles are respectively charged positively and negatively, the large ones having an opposite charge to the small ones surrounding them, the two kinds of particles should be separable by electrolytic means. Experiment verifies this completely. When a current is passed through a mixture of the two colours, a yellow liquid collects at the (—) pole, and an intensely green liquid at the (+) pole. The green liquid is composed chiefly of particles of Prussian blue. When the two colouring matters are electrolysed separately, the Prussian blue collects at the (+) pole and a clear liquid at the (—) pole, whilst electrolysis of naphthol-yellow for 2½ hours produced no effect but decomposition of water. It follows that naphthol-yellow is a good conductor of electricity, and that Prussian-blue particles are charged negatively. G. E. A.

514. *Iodoform as a Photometer.* **W. B. Hardy and Miss Willcock.** (Röntgen Ray, Archives, 8. p. 100, Nov., 1903.)—Reference is made to the observations of the authors on the change of colour experienced by a solution of iodoform in chloroform under the action of gaslight, faint daylight, Röntgen rays, and radium rays. [See Abstract No. 298 (1904).] The application of the effect as a delicate means of comparing intensities of light is suggested. J. J. S.

515. *Measurement of very Small Angles.* **M. Brillouin.** (Comptes Rendus, 137. pp. 786–787, Nov. 16, 1903.)—Two nicols are set for extinction. Between them insert (1) a thick slab of spar, cut at 45° to its axis; (2) a half-wave plate, placed at 45° to the section of the spar; (3) a second slab of spar identical and parallel to the first. The half-wave plate reduces these three to be equal optically to a slab of very small thickness. In parallel light, we obtain a uniform colour when the light has passed the analyser. A rotation of one spar 54″ on an axis perpendicular to a principal section corresponds to a wave-length. Hence as $\frac{1}{100}$ of the breadth of an interference band can be measured, we can use the apparatus to show a movement of ½ sec. of arc. P. E. S.

516. *Galvano-technique and Photography.* **J. Rieder.** (Zeitschr. Elektrochem. 9. pp. 911–913, Nov. 19, 1903.)—An attempt to perfect a method for photography in colours is described, which makes use of the Daguerrotype process. A silver plate, on being dipped into a solution of iodine in petroleum ether, acquires a sensitive coating which passes through several

changes of colour. A straw colour being reached, the plate, after drying, is put into a printing frame under a negative and exposed from 2 to 30 minutes, treated with mercury, warmed to 50° until the picture has developed, when it is placed in sodium sulphite or cyanide of potassium to remove the silver iodide. The plate is then washed with water and made the anode of a colour bath consisting of a solution of lead oxide in caustic potash. The current is passed for short periods until the colours have developed. G. E. A.

517. *The Function of Time in Luminous Sensation.* **A. Broca** and **D. Sulzer.** (Comptes Rendus, 137. pp. 944–946, Nov. 30, 1903.)—By an arrangement of mirrors and prisms, one half of a plane surface is lighted by coloured light which is constant, the other half by light of the same colour, which, before falling on it, passes through a hole in a revolving disc of brass. When the disc is in motion, the light is rendered intermittent, and the duration of the beams can be regulated and measured. The intensity of the light on either half can also be regulated and measured. The position of the eye of the observer is fixed by a tube, the axis of which, if prolonged, meets the plane surface at the centre of the line dividing the two halves. In the experiments, the light on each half is first regulated so as to be equal and of known intensity. The disc is then set in motion. The light on the one half is thereby rendered intermittent, each beam lasting a known interval of time. The light on the other half is then adjusted until both halves again appear of equal brilliancy, which is measured by the photometer. By this method curves can be traced showing the intensity acquired by a given light at the end of a given time. They are analogous to those obtained with white light, and show that the luminous sensation reaches a maximum notably greater than that which it acquires when the light is permanent. But with the same intensity measured when constant, blue light and green light give maxima greater than white and less than white respectively, while red has intermediate properties. [See also Abstract No. 2211 (1902).] H. W. P. Y.

518. *The Function of Time in Luminous Sensation.* **A. Broca** and **D. Sulzer.** (Comptes Rendus, 137. pp. 977–979, Dec. 7, 1903.)—A diagram is given showing the curves obtained by methods described in a previous communication. [See preceding Abstract]. From these curves it is obvious that if a blue light and a light of another colour have the same brilliancy when permanent, if they act on the eye for a sufficiently brief interval of time, the blue will be apparently more brilliant than the other colour, and in the same way red would appear more brilliant than green. An experiment is described to show that retinal fatigue due to blue accumulates in the retina and requires a relatively long time to dissipate, even when the duration of the coloured light has been very short. The same phenomena exists for red, but in an infinitely less degree. H. W. P. Y.

519. *The Function of Time in Luminous Sensation.* **A. Broca** and **D. Sulzer.** (Comptes Rendus, 137. pp. 1046–1049, Dec. 14, 1903.)—The authors have previously shown that when white or coloured light acts on the retina, the sensation it produces does not at once attain its permanent value. [See two preceding Abstracts.] The curves obtained by their method give the march of the phenomenon of the adaptation of the retina to light. During the first period (period of addition) the sensation increases

proportionally with the time. The subsequent fall of the curve shows that the retina is becoming less sensitive and manifests retinal fatigue. Blue light causes much greater retinal fatigue than white light of the same intensity, red light approximately equal to white, while green produces much less fatigue. The mean radiations of the spectrum are those for which the human eye functions most economically. H. W. P. Y.

520. *Effect of Magnetism on Chemical Reactions.* **A. Schweitzer.** (Phys. Zeitschr. 4. pp. 852–854, Dec. 1, 1903.)—As the result of a large number of experiments on many kinds of sensitive plates and papers, in magnetic fields varying from 6,500 to 28,000 c.g.s., the author concludes that silver-halogen salts and iron salts sensitive to light undergo no perceptible change of chemical composition. Further, no acceleration or retardation of photo-chemical reactions can be shown to be due to the magnetic field. G. E. A.

521. *Photography by Electric Discharges.* (Scientific American, 89. p. 405, Dec. 5, 1903.)—Designs capable of furnishing *motifs* for ornamentation are produced by directing the electric discharge on to a prepared sensitive plate. The preparation consists in covering the plate with pasteboard from which the design has been cut out. The plate is sprinkled, by means of a sieve, with an insulating powder, and the design may be complicated by using different powders, &c. The discharge produces a beautiful pattern recalling, by their general appearance, the figures of Lichtenberg. The process is due to S. Leduc, of Nantes. G. E. A.

522. *Stereoscopic Diapositives for Projection.* **M. Petzold.** (Phys. Zeitschr. 4. pp. 890–891, Dec. 15, 1903. Report read before the 75 Naturforscherversammlung at Cassel, Sept. 22, 1903.)—A method for giving a stereoscopic appearance to projected pictures consists in preparing gelatine plates with bichromate of potash; the stereo-negatives are then copied and the plates washed. One half picture is now put in a red colouring solution and the other in a green one. After washing, the two halves are mounted, the one over the other, and the projected picture, when viewed through spectacles with red and green glasses, gives the desired stereoscopic effect. G. E. A.

523. *Thermopile Measurements in the Ultra-violet Region.* **A. Pflüger.** (Phys. Zeitschr. 4. pp. 614–615, Sept. 1, and pp. 861–862, Dec. 15, 1903.)—The thermo-electric method is employed to determine the absorption by glass, &c., in the most actinic part of the spectrum, as far as the absorption, taking place in the quartz apparatus employed, would allow. Pending a fuller account, the following example of results is given :—

Calcspar, 4 mm. thick	Wave-length in $\mu\mu$	214	235	258	271
	Transmitted radiation (per cent.)	35	64·5	73	76·5
Quartz, 10 mm. thick	Wave-length in $\mu\mu$		214	230	280
	Transmitted radiation (per cent.)		81·5	85·3	86·5

The application of the method rests on the fact that the spark spectra of several metals are very rich in energy in the ultra-violet, especially in the regions of shorter wave-length. In the second paper, the author mentions results obtained by means of a fluorspar apparatus with which the Al lines for

$\lambda = 186\ \mu\mu$ give deflections of 200 scale divisions. This group of lines is probably the strongest in the whole spectrum, at any rate stronger than those of 199 and 193 $\mu\mu$. G. E. A.

524. *Demonstration of Infra-red Rays.* **F. Giesel.** (Phys. Zeitschr. 4. p. 862, Dec. 15, 1903.)—The rays, after passing through a filter of iodine in carbon disulphide, or of ebonite, are projected on a screen of sidot blende, which has the property of becoming phosphorescent when excited by short waves, this phosphorescence, however, being extinguished by long wave radiation. The screen is made phosphorescent by means of an arc lamp, the rays of which are passed through a piece of Jena blue-violet glass. On interposing the plate of ebonite covered with a pattern cut out of black paper, the parts of the screen behind the paper remain phosphorescent while the other parts become dark. A method is also given for demonstrating the glow of the screen which precedes the extinction. G. E. A.

525. *Intensity of the Light of Stars.* **C. Fabry.** (Comptes Rendus, 137. pp. 1242–1244, Dec. 28, 1903.)—In continuation of his experiments on the intensity of the solar illumination [see Abstract No. 278 (1904)], the author determines the intensity of the starlight by producing the image of the star and of a known source of light by the side of one another. He finds the illumination produced at sea-level by Vega when near the zenith is equal to that of one bougie décimale at a distance of 780 m., *i.e.*, equivalent to $1{\cdot}7 \times 10^{-6}$. The sunlight would be 6×10^{10} times stronger. Assuming Vega to be a star of magnitude 0·2, the relation between the magnitude g of a star and its intensity of illumination E would be expressed by $g = -14{\cdot}2 - 2{\cdot}5 \log E$, and the magnitude of the sun would be $-26{\cdot}7$. H. B.

526. *Measurement of Illumination.* **F. F. Martens.** (Deutsch. Phys. Gesell., Verh. 5. 24. pp. 436–440, Dec. 30, 1903.)—The author describes an instrument he has devised for the measurement of the illumination on a given surface. This is effected by comparing the said illumination with that reflected by adjustable mirrors from a standard source. The position of the mirrors is so adjusted that the illuminations appear to be equal, and the scale on the outside of the instrument gives the reading required after the necessary constants have been determined. W. H. S.

527. *Comparison of Thicknesses.* **Mesnager.** (Comptes Rendus, 138. pp. 76–77, Jan. 11, 1904.)—The author modifies Perot and Fabry's well-known interference method by using as compensator, instead of a layer of air enclosed between two half-silvered glass plates inclined at a small angle, a thin plate of quartz cut parallel to the axis, with faces forming the same angle as the plates of the usual method. This plate placed between two parallel nicols gives the same fringes as the half-silvered plates, but about two hundred times as wide. The accuracy is thus greatly increased. W. S.

528. *Theory of Light for Active Crystals.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 155–185, 1903.)—The author remarks that the optical properties of naturally active crystals have frequently been investigated, both theoretically and experimentally, but so far with hardly satisfactory results. Most of the observations have been made on light, the direction of which was nearly that of the optical axis, and are therefore of little use in the elucidation of certain problems. The older

theories also, though in fair agreement with observed facts, cannot be held to be accurate in the light of more recent electromagnetic theory. An attempt made by Drude to base the equations for active substances on modern foundations (Drude's "Optics") is an important step, but has two weak points. On the one hand, only one physical constant is obtained, and on the other hand, the equations do not agree with the energy equation of electrodynamics. The author's earlier theory differed from Drude's on both these heads. The present paper goes more thoroughly into the whole subject, and shows mathematically and experimentally the points of difference between the theories. The fundamental equations of the electromagnetic theory of light for an ordinary crystalline medium with a principal Z axis, are, according to the form hitherto in vogue—

$$(1)\qquad \partial\xi/\partial t = v\left\{(\partial C/\partial y) - (\partial B/\partial z)\right\}, \text{ \&c.}$$

$$(2)\qquad \partial A/\partial t = v\left\{(\partial Y/\partial z) - (\partial Z/\partial y)\right\}, \text{ \&c.}$$

$$(3)\qquad \xi = X + \Sigma\xi_h, \text{ \&c., } h = 1, 2, \ldots n;$$

$$(4)\qquad \begin{cases} \xi_h + a_h(\partial\xi_h/\partial t) + b_h(\partial^2\xi_h/\partial t^2) = e_h X \\ \eta_h + a_h(\partial\eta_h/\partial t) + b_h(\partial^2\eta_h/\partial t^2) = e_h Y \\ \zeta_h + a'_h(\partial\zeta_h/\partial t) + b'_h(\partial^2\zeta_h/\partial t^2) = e'_h Z \end{cases}$$

Where R (A, B, C) represents the magnetic field; K (X, Y, Z) the electric field; K_h (ξ_h, η_h, ζ_h) the electric polarisation of individual molecular groups; and K (ξ, η, ζ) the total electric polarisation; v is the velocity of light in a vacuum, and a_h, b_h, e_h, a'_h, b'_h, e'_h are parameters of the particular substance.

In order to render these equations applicable to monoaxial enantiomorphic crystals, it is necessary to amplify them in order to take account of their peculiar form of symmetry. It appears that polar and axial vector components should occur added to one another. For instance—

$$(5)\qquad d_h\partial A/\partial t;\ d_h\partial B/\partial t;\ d'_h\partial C/\partial t;$$

where d_h and d'_h are constants, may be added to the left-hand sides of (4); we can obtain from (2) a further set of values for (5), namely—

$$(6)\quad vd_h\left\{(\partial Y/\partial z) - (\partial Z/\partial y)\right\};\ vd_h\left\{(\partial Z/\partial x) - (\partial X/\partial z)\right\};\ vd'\left\{(\partial X/\partial y) - (\partial Y/\partial x)\right\}$$

These forms, given by Drude for the case $d_h = d'_h$, lead to a very complete explanation of the phenomena of natural circular polarisation. They have, however, the disadvantage that the system of equations obtained no longer satisfies the energy equation, for on deducing the latter from them a term appears which may be either positive or negative according to circumstances. It is therefore necessary to alter the left-hand sides of the equations (2) to the form—

$$(8)\quad \Sigma_h(d_h/e_h)(\partial^2\xi_h/\partial t^2);\ \Sigma_h(d_h/e_h)(\partial^2\eta_h/\partial t^2);\ \Sigma_h(d'_h/e'_h)(\partial^2\zeta_h/\partial t^2);$$

or, which is equivalent, to write equations (2) as—

$$(9)\qquad \partial\alpha/\partial t = v\left\{(\partial Y/\partial z) - (\partial Z/\partial y)\right\}; \text{ \&c.}$$

where α, β, γ are the components of a magnetic polarisation ρ, given by—

$$(10)\qquad \alpha = A + \Sigma_h(d_h/e_h)(\partial\xi_h/\partial t); \text{ \&c.}$$

With these amplifications the energy equation now assumes its proper form, If the constants d_h and d'_h of (8) be distinguished from those of (5) by a bar drawn above, the fundamental equations take the form—

$$\partial\xi/\partial t = v\{(\partial C/\partial y) - (\partial B/\partial z)\} \text{ ; \&c. ...}$$

$$\partial a/\partial t = (\partial A/\partial t) + \Sigma(\bar{d}_h/e_h)\,(\partial^2\xi_h/\partial t^2) = v\{(\partial Y/\partial z) - (\partial Z/\partial y)\} \text{ ; \&c.}$$

$$\xi = X + \Sigma\xi_h \text{ ; \&c.}$$

$$\xi_h + a_h(\partial\xi_h/\partial t) + b_h(\partial^2\xi_h/\partial t^2) + d_h(\partial A/\partial t) = e_h X \text{ ; \&c.}$$

Drude's hypothesis assumes $d_h = d'_h$, $\bar{d}_h = 0$, $\bar{d}'_h = 0$. The author then goes into a number of particular cases, and obtains approximate laws for the velocity of propagation and the ellipticity. He arrives at the conclusion that observation of the ellipticity of waves propagated in a direction normal to the principal axis provides a simple method of deciding between Drude's theory and his own. An experimental test shows that Drude's theory does not agree with observed facts, and confirms his own. The equations for biaxial crystals, such as the hemihedric group of the rhombic system, are next given, and various consequences deduced. J. E.-M.

529. *Process for Developing Photographic Plates in Daylight.* (Soc. Chem. Ind., Journ. 23. p. 130, Feb. 15, 1904.)—A short account of A. Lumiere's process, by which the use of a dark-room and artificial light can be dispensed with. Sodium sulphite is mixed with a substance giving a coloured solution capable of absorbing actinic rays. Picric acid and picrates, in presence of sodium sulphite, give orange-red solutions which absorb the actinic rays; picrates do not stain the film. L. H. W.

530. *Elliptic Polarisation of Light by Reflection from Solutions of Substances with Surface Colours.* **E. Lischner.** (Ann. d. Physik, 12. 5. pp. 964–983, Nov., 1903. Extract from the Griefswald Inaugural Dissertation.)—The constants for reflection from solid mirrors of such substances have been determined by many observers, but quantitative results for reflection from solutions have not hitherto been published. The fact that these solutions show decided metallic lustre led the author to investigate them. The method lends itself especially to examination of the absorption bands, where the great opacity of the substance in the solid state makes direct measures of the absorbing power impossible. Surface irregularities are much more troublesome in the case of solutions than of solids, and especially so when water is the solvent. Hence the author used chiefly solutions in alcohol and chloroform, which were placed in tall vessels, the orifices of which were small relatively to their volumes. Sénarmont's method of investigation, as modified by Wiedemann, was employed, an arc light serving as source. For comparison with other observers' results, observations were also made on solid mirrors of the substances examined, viz., fuchsine, brilliant-green, fluorescine, and cyanine. The values for n, the index, obtained from mirrors agree pretty well, but the author's values for K, the absorption coefficient, are smaller throughout than those of other observers. He also places the maximum absorption for fuchsine at the F line instead of the E line—a result which, however, is borne out by Merkel. The general run of the index was much the same for solutions as for solids, but in brilliant-green the minimum was shifted from E to D. While the absorption coefficient naturally increased with the concentration, it did not do so in regular proportion. Jamin's law, that the index $n = 1{\cdot}4$ marks the boundary between positive and negative reflection from solutions, did not hold; for example, the light of the F line ($n = 1.06$) was always reflected positively from a fuchsine mirror. As regards the behaviour of individual substances, with fuchsine and fluorescine the elliptic polarisation increased rapidly with the concentration. A remarkable feature with brilliant-green was the diminution of ellipticity on adding water to the alcohol used as solvent. A 10 per cent. solution in pure water behaved almost like water. Cyanine can only be dissolved in small quantities in alcohol and chloroform. Its absorption band appears to be nearer the red for the latter. The surface colour is very different for the two media. Cyanine in chloroform showed a bronze surface shimmer which turned blue on exposure to light, so that in strong sunshine photographs of sharply defined objects could be obtained. When a spectrum was projected on the surface the yellow—*i.e.*, the most strongly absorbed—rays were by far the most active in producing this surface-colour film. [The author betrays no acquaintance with Wood's work on these substances.] A. E.

531. *Change of Phase by Reflection in Silvered Quartz.* **J. M. de Lépinay** and **H. Buisson.** (Journ. de Physique, 2. pp. 881–887, Dec., 1903.)—A plane-parallel quartz plate, 1 cm. thick, half-silvered over half of each face, is covered by a screen with two openings, and a monochromatic image projected successively on the two openings. The change of phase is calculated from the change in diameter on passing from the first dark ring seen through the clear quartz to the first bright ring seen through the silvered half. The red, green, and blue lines of cadmium were employed. A second, less sensitive, method is described. G. E. A.

532. *Explanation of the False Spectra from Diffraction Gratings.* **T. Lyman.** (Phys. Rev. 16. pp. 257–266, May, 1903.)—In a previous paper the author has shown that the principal spectra produced by concave diffraction gratings are complicated by the presence of false spectra of lower order than the first, and that these false spectra are frequent, and often of excellent quality [see Abstract No. 794 (1901)]. In the present paper the theory of these false lines, as suggested by Runge, is worked out, and it is shown how the wave-lengths actually obtained can be accounted for. It must, of course, be remembered that the phenomenon of ghosts is quite different in appearance and of different origin; in this case the ghosts lie close to the parent line, but the false spectra not only occur in regions many hundred units from the original, but also differ fundamentally from ghosts in other respects. A plate accompanies the paper, showing some of these false lines. The same effect is produced also by certain plane gratings. E. C. C. B.

533. *Spectra of Metals in the Electric Arc.* **P. Lenard.** (Ann. d. Physik, 11. 3. pp. 636–650, June 4, 1903.)—An investigation into the intensity distribution of the various spectrum lines in the different parts of the arc. A vertical arc was used between carbon poles, the positive pole being the lower, and having small quantities of sodium or lithium salts introduced into the crater. If a magnified image of such an arc containing sodium be thrown upon a ground-glass plate, the various portions of the arc can be examined by means of a hand spectroscope, when it will be seen that the only sodium line visible in the outermost portion is the D line; this is the only line of the principal series in the visible region. A better way to work is to remove the slit of an ordinary spectroscope and to focus a very small image of the

arc exactly in the focal plane of the collimating lens. In the eyepiece there is then seen a series of spectral images of the arc, and the distribution of the various radiations can be readily investigated. It may be noticed here that the arc consists of two separate flames, one starting from each pole, and these flames, if the current is strong enough, mingle together in the space between the carbons. If, however, a weak current is passing, then the flame from the lower or positive pole forms the principal portion of the arc, and the flame from the upper pole only reaches a short distance from the pole and is then turned back again towards its origin. In the spectroscope it will be seen that the flames corresponding to the principal series are the largest, occupying the full extent of the arc. The flames of the first subordinate series are distinctly smaller, and smaller still are those of the second subordinate series. The flames of the principal series stretch also from pole to pole, while those of both subordinate series are seen with a broad dark space between—that is to say, they stretch only a short distance from the two poles. These observations make it clear that the metallic lines in the arc do not depend upon the actual path of the current, but upon the shape and form of the flame itself. Experiments with absorbing layers show that these appearances are not due in any way to the relative intensity of the lines. For example, if an absorbing layer is inserted to diminish the relative intensity of the red lithium line until it is weaker than the lines of the subordinate series, the size of the flame corresponding to it is not considerably diminished. There is therefore no doubt that the entire mantle of the arc shows only the principal series, and that the first subordinate series is emitted by an inner layer; the second subordinate series being given by a layer inside this again. It might be considered that these facts argue in favour of the arc being the same as a Bunsen flame, only very much hotter—that is to say, that the number and intensity of the lines increase towards the centre of the arc. This, however, is not the case, because it would then be possible to make the flame of the sodium D line as small as desired by decreasing the current strength, but under these circumstances a limiting size of the flame is soon reached. Now the flames corresponding to all the series are quite hollow; they are, in fact, only mantles surrounding a dark centre. The flames of the principal series have the largest hollow centre; the flames of the first subordinate series just fit this hollow, and again, their hollow centres are just filled by the flames of the second subordinate series. The hollow cores of the flames of the second subordinate series are either free from metallic radiations or certain hitherto unobserved series. It is possible in this way to separate the lines of an element into their series. When the ordinary carbon arc is examined in this way, the flames due to the carbon and cyanogen bands are, of course, seen. These flames, however, are not hollow, and if a small quantity of a metallic salt is then inserted, it will be seen that these flames just fill the hollow cores of the flames of the second subordinate series of the metal. In the case of sodium the hollow cores of the second subordinate series show a new series of metallic lines which are probably those of a third subordinate series; these have the following wave-lengths: 5530, 4915, 4638, 4470 tenth metres. Besides these and inside them were to be seen some more radiations which appeared only as small cones on the poles of the arc. The companions or satellites of the first subordinate series were seen, and the most distinct are doubtless the pair given by Kayser and Runge at $\lambda = 5675{\cdot}92$ and $\lambda = 5670{\cdot}40$ tenth metres. The satellites of the second subordinate series were seen at $\lambda\lambda = 527$, 510, 482, and 472 $\mu\mu$. The existence of these satellites brings sodium into closer analogy with other metals. In explanation of these results, the author considers that each series is due to a separate and distinct type of vibration of the electrons in the atom, and, further, that as the atoms are volatilised and pass out through the flame of the arc, they are subjected to a series of disturbances which produce these vibrations in turn.

E. C. C. B.

534. *Electrode-light in Liquids applied to Spectroscopy.* **W. v. Bolton.** (Zeitschr. Elektrochem. 9. pp. 767–769; Discussion, pp. 769–771, Sept. 10, 1903. Paper read before the 10 Hauptversammlung der Deutsche Bunsen Gesellsch. für angewandte Chemie, Section 10 of the 5th International Congress at Berlin, June 3–8, 1903. Also Zeitschr. Elektrochem. 9. pp. 913–922, Nov. 19, 1903.)—The author has found that the bright light emitted at the wire electrode of a Wehnelt interrupter, when it forms the kathode and dips into dilute acid, yields a line spectrum which is characteristic of the metal of which the wire is made; and that if the electrode is of platinum, and the electrolyte contains some other dissolved metal, then the light yields the characteristic line spectrum of the dissolved metal, whilst the platinum spectrum is suppressed. The first paper contains a general account of his experiments, in which attempts were also made to obtain spectra, using the electrode as anode. In this case the light seems to be due to the formation of a gas sheath over the immersed wire, which is traversed by numerous small sparks. The light emitted is very feeble, and line spectra are not obtained. In the former case, with the wire as kathode, the author supposes that a small quantity of the metal dissolves in the electrolyte and becomes ionised. The ions, under the action of the high p.d. of 110 volts, and the consequent violent bombardment of the kathode, are brought to the state of glowing vapour, and emit their characteristic line spectra. A similar explanation applies to the case in which the metal is dissolved in the electrolyte. In the discussion this view was criticised by K. Arndt. The author also describes a curious polishing action on the surface of a carbon electrode used as an anode, which is referred to by several speakers in the discussion. The second paper describes the apparatus used and gives numerous diagrams of the spectra obtained, along with comparison spectra of hydrogen and platinum. For the purpose of investigating salt solutions the apparatus of Fig. 1 was used. P_1 and P_2 are platinum wires forming the kathode and anode respectively. The tube R contains the electrolyte, preferably consisting of 1 part of nitric acid to 4 parts of water, to which is added a small quantity of an aqueous solution of the salt. K is a water-jacket, and A a coiled tube to silence the noise produced by the passage of the current. The

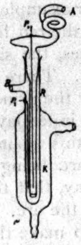


FIG. 1.

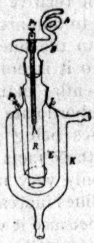


FIG. 2.

kathode P_1 is enclosed in a tube to prevent explosion of the gases produced. This type of apparatus the author calls the electrolyte-chromoscope. When the metal to be examined is to form the kathode, the metal-chromoscope shown in Fig. 2 is employed. P_1 is, in this case, a rubber-protected rod holding the wire electrode at its lower end. The electrolyte used is dilute nitric acid of the above strength. A p.d. of 110 volts at the terminals of the apparatus, without any intermediate resistance, is found most suitable, and the switch should, as a rule, be closed before inserting the kathode into the electrolyte. The current through the apparatus is not intermittent as in the ordinary Wehnelt effect, nor is the electrode raised to incandescence or melted, although a powerful hissing noise is produced. The spectra obtained in all cases, with the exception of those of zinc and cadmium, exhibited the hydrogen line $H\alpha$, which was used as a reference line in mapping them. Electrodes formed of brass and of a nickel-copper alloy yielded the superposed spectra of their constituent metals. The sensitiveness of the method is such that 1 mgm. of sodium nitrate dissolved in 10 litres of distilled water could be easily detected. Certain peculiarities in the spectra obtained are pointed out, such as the appearance of a new line in the sodium spectrum, and of fluted bands in those of aluminium, magnesium, and iron. [See also Abstract No. 2036 (1900).] J. D. C.

535. *Photometric Measurements of the Spectra of Gases.* **G. Berndt.** (Ann. d. Physik, 12. 5. pp. 1101–1114, Nov., 1903. Extract from "Abhandlungen der Naturforschenden Gesellschaft zu Halle," 26, 1903.)—Photometric observations were made of certain lines in the spectra of nitrogen and hydrogen by means of a Glan spectrophotometer. It was found that between the limits of about 8 mm. and 0·05 mm. pressure the intensity was directly proportional to the quantity of current carried by the gas at constant pressure, and that with constant current strength the intensity increased with decreasing pressure, at first slowly and then more rapidly. In the latter portion of the paper the theoretical aspect of these results is discussed, and the author shows that the facts are in accordance with the theory. E. C. C. B.

536. *Ultra-violet Spark Spectrum of Selenium.* **G. Berndt.** (Ann. d. Physik, 12. 5. pp. 1115–1118, Nov., 1903.)—This spectrum was obtained by passing the condenser discharge between platinum wires upon which some selenium had been melted. The wave-lengths of the lines are given in a table, and extend from $\lambda = 4844$ to $\lambda = 2354$. There are about 60 lines between these limits, and the probable error lies between 0·1 and 0·4 A.U. for the ultra-violet and visible ends respectively. E. C. C. B.

537. *Spectrum of Lightning.* **P. Fox.** (Astrophys. Journ. 18. pp. 294–296, Nov., 1903.)—The spectra of lightning-flashes were photographed by means of an objective-prism spectroscope and compared with the air spectrum taken upon the same plate. A table is given of the wave-lengths of the lines obtained, together with the corresponding air lines. Some curious facts were observed in studying the spectra, in that the relative intensity of some of the lines varied during the flashes. For example, in the first flash, the line at $\lambda = 4349$ diminishes rapidly in intensity from the cloud to the ground. Again the line, a combination of $\lambda = 4074$ and $\lambda = 4106$, at the top of the flash is one of the heaviest lines, being much stronger than its two neighbours $\lambda = 4041$ and $\lambda = 3997$. Towards the ground the last two lines have increased

until they are equal to the strongest lines, whilst the first line has become faint. The same changes are not visible in the second flash, where only a slight increase towards the ground is noticed in the line at $\lambda = 4439$.

E. C. C. B.

538. *Economising Light in Spectrum Analysis.* **W. J. Humphreys.** (Astrophys. Journ. 18. pp. 324–340, Dec., 1903.)—Under the headings: Illumination of the slit; Virtual increase of the slit length; Shape of grating; and Camera attachments, various devices for increasing the brightness of the spectrum are considered. With slit grating, and camera arranged, as in the Rowland mounting, on the vertices of a right-angled triangle, it is found that, to reduce astigmatism to a minimum, the surface of the grating should be part of an elliptical torus. Choosing, for simplicity, a circular torus, it is shown that zero astigmatism is obtained by having the radii of horizontal and vertical curvature of the grating equal respectively to its distances from the camera and the slit. G. E. A.

539. *Spectrophotometric Measurements by Means of Photography.* **C. Camichel.** (Journ. de Physique, 2. pp. 899–903, Dec., 1903. Abstract from les "Annales de la Faculté des Sciences de Toulouse.")—The author measures the relative intensity of two beams of light by comparing the relative densities of the silver images obtained when a photographic plate is exposed to both the sources for the same period. It was necessary, before any experiments were carried out, to test the homogeneity of the plates used; this was done by exposing various portions of the gelatine emulsion to a constant source of light for exactly the same time, and then by comparing the densities of the images produced. This comparison was made in the following way: an image of a Nernst lamp was thrown upon the finished plate, and an image of this image, formed by a second lens placed behind the plate, directed upon a thermopile. The throw of the galvanometer in connection with the thermopile gave a measure of the relative transparency of the silver images. It was found that the best plates are surprisingly homogeneous. The method of comparing two sources is based on the foregoing; portions of a photographic plate are exposed for equal times to the standard source alternating with the unknown source, the intensity of which is altered, probably by moving it nearer to or farther from the spectroscope. The relative transparencies of the images are plotted upon curves against the positions upon the plate; two curves are drawn, one for the even images and one for the odd. One of these curves therefore simply records any possible variation in the standard source. From these curves the relative intensity of the two sources can be obtained with great accuracy. The apparatus employed consisted of a three-prism spectroscope, and just in front of the plate was placed a diaphragm with a small slit cut in it to isolate the radiation required. The author also shows that in such measurements it is absolutely necessary to give the same exposure throughout one series of comparisons. E. C. C. B.

540. *Spectral Energy Curve of a Black Body at Room Temperature.* **G. W. Stewart.** (Phys. Rev. 17. pp. 476–488, Dec., 1903.)—Fault is found with the work of Langley and of Mendenhall and Saunders upon the spectral energy curves of black bodies at low temperatures. In the usual form of apparatus the black body is placed in front of the slit, and its spectrum thrown upon the bolometer slit. The galvanometer deflections obtained are evidently a

measure of the interchange of energy between the bolometer and the black body. If the black body is much cooler than the room, the deflections are proportional to the emission of energy by the bolometer, since the energy emitted by the black body is so small. Langley and Mendenhall and Saunders thought that the deflections gave the distribution of energy in the spectrum of the black body, no matter what its temperature. Some measurements were made by the author of the emission spectrum of a black body at ordinary temperatures by measuring the interchange of energy between a carefully blacked radiometer vane and a black body in liquid air, and the results are given in the paper. At 24° the maximum intensity emitted was found to have the wave-length $9·2\mu$ (corrected according to Paschen's method). The value calculated from the equation $\lambda_m T = A$ is $9·8\,\mu$, and the values obtained from Planck's equation also do not agree with those observed. [In the paper Figs. 4 and 6 must have been accidentally interchanged.]

E. C. C. B.

541. *Principal Characteristics of Line and Band Spectra with some Considerations upon the Origin of the Two Types.* **H. Deslandres.** (Comptes Rendus, 137. pp. 1013–1018, Dec. 14, 1903.)—A short account of the author's theory of band spectra; he showed that band spectra can be expressed by a function with three independent parameters, in which may be seen an analogy here with the group of sound waves emitted by a solid body. He does not agree with Runge's theory that while the vibrating electrons give rise to line spectra, the positive nucleus might possibly vibrate in such a way as to produce band spectra. E. C. C. B.

542. *Wave-lengths of Lines of the Solar Spectrum and Corrections to Rowland's Tables.* **A. Perot** and **C. Fabry.** (Annal. Chim. Phys. 1. pp. 5–8, Jan., 1904.)—A further reply to criticisms of the authors' paper of Jan., 1902 [see Abstracts Nos. 675 (1902) and 46 (1903)], in which they described a method of measuring wave-lengths, and pointed out that Rowland's tables exhibit systematic errors. Among the various causes of error suggested by Bell, the only one which would produce systematic error is alteration of wave-length by radial motion of the observer, owing to the earth's rotation and the eccentricity of her orbit. Details are given to show that this was well guarded against. The authors draw attention to the fact that their curve, being deduced solely from observations of the solar spectrum, is only applicable to Rowland's solar wave-lengths. Their corrections of Rowland's numbers not only do away with errors in relative values, but correct the absolute values so as to bring them into agreement with the absolute values of the wave-lengths of cadmium rays found by Michelson and Benoît. Hartmann's correction curve, which only aims at correcting the relative values, is obtained by adopting a unit of length chosen so as to distribute the positive and negative corrections equally. This would mean a departure from the metric system, and such a change of unit would be inconvenient for applications outside pure spectroscopy. Hartmann's solution can therefore hardly be admitted except as a provisional one. A. E.

543. *Phosphorescence Excited by Slow Kathode Rays.* **A. Wehnelt.** (Deutsch. Phys. Gesell., Verh. 5. 23. pp. 423–426, Dec. 15, 1903.)—The author has obtained bright fluorescence in the case of various substances, such as Thuringia glass, with very small velocities, expressed by 300 volts or less.

Lenard recently stated that the velocity expressed by 6,000 volts was the smallest at which he could obtain fluorescence in the case of Thuringia glass. The author has again exposed some substances to kathode rays of low velocity to find the lower limit at which fluorescence is excited. He has found for Thuringia glass the limiting value of the potential is about 260 volts, while Lenard's number is about 6,000 volts; for Balmain's luminous paint 300 volts; for ZnS about 145 volts (Lenard, 1,700 volts); for uranium glass 670 volts (Lenard, 5,800 volts). The true beginning of fluorescence the author considers is at even lower potentials for the kathode rays employed by him. He notes that the radiation-density (*i.e.*, the quantity of electricity traversing the unit of cross-section in 1 sec.) employed by Lenard was exceedingly small, being only $0{\cdot}57 \times 10^{-10}$ Coulombs/sec. (cm.)^2, while the radiation density in his own experiments was on the average about 10^{-3} Coulombs/sec. (cm.).^{2} Thus it appears probable to the author that the values given by Lenard have no general validity, but apply only to the rays transporting an extremely small charge of electricity with which he worked. J. J. S.

544. *Chemical Effect of Röntgen Rays.* **R. Luther** and **W. A. Uschkoff.** (Phys. Zeitschr. 4. pp. 866–868, Dec. 15, 1903.)—In testing the chemical effect of Röntgen rays on various sensitive materials, it is found that their effect on gelatino-bromide papers and plates is quite different to that of light. The gelatino-bromide is changed by a previous exposure to Röntgen rays, so as to become, according to circumstances, more or, it may be, less sensitive to light. Also previous exposure to light exercises no influence on the behaviour of gelatino-bromide of silver under the action of Röntgen rays. The exposure of a gelatino-bromide of silver paper to diffused daylight brings out the latent image of a Röntgen-ray exposure, the latter image being darker even after the paper has been exposed for some days 2 m. from a window with a north aspect. G. E. A.

545. *Becquerel Rays and Water.* **F. Kohlrausch.** (Deutsch. Phys. Gesell., Verh. 5. 15. pp. 261–262, Aug. 15, 1903.)—A mixture of about $\frac{1}{2}$ gm. radium bromide with 2 gm. barium bromide was put in a capsule which was closed with a plate of aluminium 0·1 mm. thick. The rays passed through a layer of water, 18 mm. thick, in a resistance trough of the usual form, made from Jena thermometer glass, the thickness of the walls being about 1 mm. The trough had stood with water two years since it was set up, and at the time of observation was filled up with 25 c.c. of distilled water. Sudden action of the radiation did not appear. Observations were made with and without the action of the rays. The conductivity increased from the initial value $1{\cdot}1 \times 10^{-6}$, and the increase due to the radiation was on the average about $0{\cdot}01 \times 10^{-6}$. It decreased with time. If the above increase of conductivity is reckoned as due to ions of ordinary mobility, the order of quantity is $\frac{1}{5000}$ milligramme. It is possible that the radiation hastens the solution of the glass wall of the containing vessel. J. J. S.

546. *Penetrating Radiation from the Earth's Surface.* **E. Rutherford** and **H. L. Cooke.** (Phys. Rev. 16. p. 183, March, 1903. Abstract of a paper presented at the meeting of the American Physical Society held on Dec. 31, 1902.)—Experiments are described which show that about 30 per cent. of the ionisation inside a closed vessel is due to an external radiation of great penetrating power. This radiation appears to come equally from all directions, and is probably due to excited activity on the surface of the room in which the observations were made. A screen of lead 5 cm. thick was found to cut down the rate of discharge of a well-insulated gold-leaf system by 30 per cent. Increasing the thickness had no further effect. The effects got were not due to the presence of thorium and radium, as the ionisation occurred in a room free from all possible contamination by radio-active substances. In brass vessels which had been thoroughly cleaned the rate of discharge corresponded to a rate of production of 10 ions per c.cm. per sec.

J. J. S.

547. *Radio-activity of Hydrogen Peroxide.* **O. Dony-Hénault.** (Bull. de l'Assoc. Belge des Chim. 17. pp. 365–373, 1903.)—Experiments were made to ascertain the relationship between the radio-activity of H_2O_2 and its rate of dissociation into water and oxygen. Both the rate of dissociation and the radio-activity are lowered as the temperature is lowered. Contrary to the opinion of Graetz [see Abstract No. 1376 (1903)], the radiations of H_2O_2 cannot reproduce H_2O_2 from the vapours present in the atmosphere.

L. H. W.

548. *Secondary Radio-activity in the Electrolysis of Thorium Solutions.* **G. B. Pegram.** (Phys. Rev. 17. pp. 424–440, Dec., 1903.)—In the electrolysis of solutions of the thorium nitrate prepared by de Haen, of Hanover, a deposit of lead peroxide is obtained on the anode, and this deposit is highly radio-active at first. The intensity of its radiations increases slightly for about two hours, then decreases, falling to half value in about eleven hours. The radiations consist chiefly, if not wholly, of the non-penetrating *a* type of radiations, with the exception that a small amount of radio-active gas similar to or identical with the thorium emanation is given off. The kathode has no secondarily active matter deposited on it. The gases liberated in the electrolysis of a thorium nitrate solution are charged with radio-active matter, doubtless the ordinary emanation from thorium, which loses its activity at the rate of half in about 1 min. From solutions of the purest thorium nitrate obtainable, no visible deposit is obtained on the anode, yet it is radio-active. The activity rapidly decreases, falling to ½ in one hour. Both anode and kathode deposits of oxides or metals from a solution containing thorium are radio-active. Their activity falls to ½ in a few minutes. Precipitates thrown down chemically from solutions containing thorium nitrate are radio-active. Their activity also decays rapidly. The secondary activity caused by thorium is not always the same in its rate of decay with time. The rate depends on how the secondarily active matter is separated from the thorium. It seems probable that the radio-activity is a property of some kind of matter derived from the thorium, which in some way becomes closely attached to the lead peroxide. It still remains to be explained how the radio-active matter comes to be so closely connected to the lead peroxide as to be precipitated with it, whether the connection is an atomic, molecular, or simply mechanical one; and how it comes to exert an influence varying with circumstances on the rate of decay of activity of the radio-active matter.

J. J. S.

549. *Lecture Experiment with Radium Rays.* **L. Bleekrode.** (Nature, 69. p. 103, Dec. 3, 1903.)—A small box containing 10 milligrammes of strongly active radium bromide was put into a Dewar's tube with vacuum jacket.

The tube was then turned upside down in a dish of mercury, so that the rays from the radium could only escape through the vacuum walls. Putting now a charged sensitive gold-leaf electroscope at a distance of 5 cm. from the tube, a leakage instantly sets in so as to cause the instrument to be wholly discharged in 15 secs. The easy transmission of radium rays through a high vacuum is thus demonstrated very simply. J. J. S.

550. *Emission of* N-*rays by Constrained Bodies.* **R. Blondlot.** (Comptes Rendus, 137. pp. 962–964, Dec. 7, 1903.)—It was found that certain bodies acquired by compression the power of emitting *n*-rays. Pieces of wood, glass, caoutchouc, &c., during compression became sources of *n*-rays, and on being brought near a mass of phosphorescent sulphide of calcium increased its brightness. They also caused the reinforcement of the action of light on the retina when brought near the eye in their compressed condition; *e.g.*, in a dimly lit, shuttered room, a clock-face, which appeared to the observer a grey, undefined stain, was seen to become whiter and more distinct when a cane was put before the eyes and bent; on unbending the cane, the clock-face became darker. Compressed glass had the same effect. These phenomena are not instantaneous; time is required for the effects to be observed. Bodies which were in a state of internal constraint were found to emit *n*-rays. Thus tempered steel, hard-hammered brass, crystalline sulphur, &c., are spontaneous and permanent sources of these rays. The experiment of the clock-face was repeated by bringing up a tool of tempered steel, such as a graving pen or a file. Similarly the phosphorescence of sulphide of calcium is increased by bringing near a small piece of it the tempered blade of a knife. These actions took place without notable enfeeblement across a sheet of aluminium 1·5 cm. thick. This emission of *n*-rays appears to have an indefinite duration. A knife-blade of tempered steel from a Gallo-Roman tomb, as well as other ancient objects, emitted the *n*-rays as much as a modern knife. These emitted rays recall the properties of uranium, radium, and other radio-active bodies. They are spectral radiations, and can be reflected, refracted, and polarised, and possess definite wave-lengths which the author has measured. Their energy is probably furnished by the potential energy which corresponds to the state of constraint of tempered steel. This expenditure of energy is no doubt extremely slight, as are the effects of the *n*-rays themselves. Bodies subjected to transitory constraint give a transitory emission of *n*-rays. J. J. S.

551. *Blondlot's* N-*rays.* **H. Zahn.** (Phys. Zeitschr. 4. pp. 868–870, Dec. 15, 1903.)—The author describes a series of careful experiments, in some of which Blondlot's procedure was followed, to attempt to reproduce *n*-rays. A selenium cell was employed to measure any change in the intensity of the flame on which the *n*-rays were supposed to fall, and an Auer lamp and quartz lens were also used. The results were entirely negative, and the author asks for more information from Blondlot regarding the details of his apparatus and experiments. [See Abstract No. 293 (1904).] G. E. A.

552. *Emission of* N-*rays by the Human Body.* **A. Charpentier.** (Comptes Rendus, 137. pp. 1049–1051, Dec. 14, 1903.)—Phosphorescence was produced on a screen of barium platino-cyanide by means of a salt of radium, then on the approach of various portions of the human organism to the screen the brilliancy of the phosphorescence was increased. Muscle and nerve especially were observed to produce this effect, and muscle acts more powerfully in proportion as it more strongly contracts. That the effect was not due to heating of the screen was proved by interposing substances which effectually kept off the heat-rays. As the body produced the observed effect on the phosphorescent screen after being nine hours in complete darkness during the night, the phenomena are not due to *n*-rays absorbed by the body, but the human body itself appears to emit *n*-rays. Physiological and medical applications are foreseen by the author. J. J. S.

553. *Blondlot's* N-*rays.* **O. Lummer.** (Deutsch. Phys. Gesell., Verh. 5. 23. pp. 416–422, Dec. 15, 1903.)—Without wishing, in the meantime, to deny the objective existence of the *n*-rays, the author points out that a whole series of Blondlot's researches may be almost completely imitated without using any source of radiation, and that the changes in form, brightness, and colour of the surfaces observed by Blondlot may be explained by what goes on in the eye itself and by the competition between the rods and cones of the retina in vision in the dark. Kries explained the function of the cones as being our apparatus for brightness fit for distinguishing colour, and the rods as blind to colour and forming our apparatus adapted for darkness. Before the cones perceive coloured light, the rods produce in the brain the impression of colourless brightness. The *fovea centralis* contains cones only, while rods predominate at the periphery of the retina. Thus in direct vision (foveal) the rods are excluded, and only come into action in indirect (peripheral) vision. With small brightness these two portions of the visual apparatus come into sharp contest, and if the dimness is great, the colour-blind rods prevail, and everything appears grey. In the author's work on "the grey-glow and the red-glow" he explains on this theory the sudden changes which occur when a body is observed in a dark room, and its temperature steadily raised. The sudden change from dark to grey, and again the sudden increase from the grey glow to the red glow are due to the successive stimulation, first of the retinal rods and then of the retinal cones. Shadowy vision is produced when the *fovea centralis* is not stimulated, and a sheet of heated platinum, for example, observed in the dark. A source of radiation is perceived but not clearly seen till the cones also are stimulated, which occurs at about 500° C. In some of Blondlot's experiments the case of the shadowy vision here described seems to be reproduced. The author has shown the effect to an audience. A dull, glowing platinum plate is first seen by extra foveal parts of the retina. On interposing the hand or a lead screen, the gaze is limited and fixed, the foveal part of the retina is brought to bear, and the action of the rods excluded. The result is that the plate appears less bright and more red-coloured. Time and effort are required for this change, as in the experiments described by Blondlot. The phenomena are thus probably subjective to a large degree, or may be described as due to objective occurrences in the retina. J. J. S.

554. N-*rays of Physiological Origin.* **A. Charpentier.** (Comptes Rendus, 137. pp. 1277–1280, Dec. 28, 1903.)—A further account is given of the rays emitted from the living body. From the frog and other animals *n*-rays are sent out, especially from the muscles and nerves. The increase of phosphorescence is not due to rise in temperature, for the frog can be kept at a temperature below that of the laboratory. Muscles rich in nerves especially emit *n*-rays; tendons do not produce increased luminescence. The compression of a nerve increases notably its power of awakening luminescence; but if the compression is prolonged the nervous radiation diminishes. Certain portions of the brain seem especially to give out *n*-rays, and the positions of these parts can be localised on screens by the increase of brightness which they cause. All nervous centres increase their emission of the radiation when they become active. The rays are transmitted through various media and follow the laws of optics, manifesting themselves by an increase of luminescence in the test object. [See also Abstract No. 552 (1904).] J. J. S.

555. *Influence of Radium Rays on Fertilised and Unfertilised Eggs and on the First Stages of their Development.* **G. Bohn.** (Comptes Rendus, 136. pp. 1085–1086, May 4, 1903.)—The eggs of a sea-urchin (*Strongylo-centrotus lividus*) were experimented with. The normal stages of development are, firstly, the formation of a spherical ciliated membrane (blastula); secondly, the formation of a digestive cavity (gastrulation); thirdly, the transformation of the gastrula into a larva called pluteus. When the radium rays are employed in the early stages before gastrulation the result is always the same: a blastula is obtained which does not further develop into a gastrula. Moreover, the segmentation which leads to the formation of the blastula is accelerated by a short exposure to the rays and retarded by a long exposure. Certain irregularities in the process are sometimes observed. If gastrulation has commenced, radium either arrests development or causes it to be performed irregularly, and larvæ are obtained having the digestive cavity replaced by an irregular mass of cells. Sometimes only the oral aperture is formed. If gastrula are submitted momentarily to the rays, they assume the pluteus form, but the expansions in the form of limbs used in natation are not developed. Radium rays quickly destroy spermatozoides, but ova submitted to their action seem to become more easily fertilised. A small percentage of the unfertilised ova thus treated developed without the concurrence of a spermatozoid. Radium rays act on the chromatin of the nucleus and augment or destroy its activity according to the length of the exposure. They kill spermatozoids which are masses of naked chromatin, but excite the chromatin of the ovule, which is protected by protoplasm, and determine parthogenesis. [See also Abstracts Nos. 92 and 300 (1904).] H. W. P. Y.

556. *Influence of Radium Rays on the Development and Growth of the Lower Fungi.* **J. Dauphin.** (Comptes Rendus, 138. pp. 154–156, Jan. 18, 1904.)—The rays from radium arrest the growth of the mycelium of the lower fungi (*Morticrella* being the fungus experimented with) and prevent the germination of the spore; this action is simply a paralysing one. They provoke the appearance of cysts in the interior of the filaments, these cysts being evidently organs of defence. The spores and the mycelium are not killed, but when placed under normal conditions germinate and develop afresh. [See also Abstract No. 92 (1904).] H. W. P. Y.

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557. *Reflecting Power and Electrical Conductivity.* **E. Hagen** and **H. Rubens.** (Deutsch. Phys. Gesell., Verh. 5. 5. pp. 113–118, March 15, 1903.)—A short recapitulation of the matter given in previous papers. [See Abstracts Nos. 62 and 64 (1904).] G. E. A.

558. *Reflecting Power and Electrical Conductivity.* **P. Drude.** (Deutsch. Phys. Gesell., Verh. 5. 7. pp. 142–144, April 15, 1903.)—The author refers the origin of the law deduced by Planck [see Abstract No. 63 (1904)] to Maxwell and to himself. In connection with the statement by Hagen and Rubens that the magnetisation of iron and nickel is unable to be induced by the infra-red vibrations [see Abstract No. 62 (1904)], the author points out that this is due, not to an inertia of the magnetic susceptibility, but to the form of the change of condition (transverse waves), at any rate from the standpoint of the explanation of magnetic susceptibility by means of rotating electrons. G. E. A.

559. *Emissivity of Metals for Long Waves.* **E. Hagen** and **H. Rubens.** (Deutsch. Phys. Gesell., Verh. 5. 7. pp. 145–148, April 15, 1903.)—A recapitulation of a previous paper [see Abstract No. 64 (1904)] and a reply to Drude's remarks. [See preceding Abstract.] G. E. A.

560. *Diffraction of Röntgen Rays.* **H. Haga, P. G. Tiddens,** and **C. H. Wind.** (Archives Néerlandaises, 8. pp. 412–493, 1903. From the Versl. d. Kon. Akad. v. Wet., Amsterdam, 5. pp. 408 and 444, 1897.)—The authors consider that they have proved Röntgen rays to consist of ether vibrations. [See Abstract No. 427 (1903).] The present paper contains a full discussion of the mathematics of the experiment, a note on apparent maxima and minima of clearness (as distinct from intensity of illumination), and a discussion of the application of Fourier's series to problems in diffraction. [See also Abstract No. 427 (1903).] W. S.

561. *New Effects of the Known Forms of Radiation.* **L. Zehnder.** (Ann. d. Physik, 12. 2. pp. 413–416, Aug. 17, 1903.)—A recapitulation of the results described in Abstract No. 1369 (1903). G. E. A.

562. *Optical Peculiarities of Hemimorphic Crystals.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 186–202, 1903.)—A development of the author's theory [see Abstract No. 528 (1904)] rendering it applicable to a large variety of crystalline forms. A number of interesting results are obtained theoretically, many of which are of such a nature that their validity may be tested experimentally. [See also Abstracts Nos. 211 and 547 (1903).] J. E.-M.

563. *Ruling of Concave Gratings.* **K. Stöckl.** (Zeitschr. Instrumentenk., Beib. 22. pp. 217–219, Nov. 15, 1903.)—The author gives diagrams of a machine to rule concave gratings in such a way as to eliminate the errors referred to by Lyman [see Abstract No. 532 (1904)]. He apparently rules them with equal spacing along the arc, not the chord of the arc. [See also Abstract No. 998 (1903).] E. C. C. B.

564. *Absorption of Gravitational Energy by Radio-active Substances.* **G. Kučera.** (Phys. Zeitschr. 4. pp. 319–320, March 1, 1903.)—The author gives in this article a revision of the mathematics and calculations of Geigel's paper. [See Abstract No. 1189 (1903).] A. D.

565. *Radio-activity of Uranium.* **E. Rutherford** and **F. Soddy.** (Phil. Mag. 5. pp. 441–445, April, 1903.)—A discussion of the different types of radiation given out by uranium—the α- and β-rays. J. J. S

566. *Radium.* **J. J. Thomson.** (Nature, 67. pp. 601–602, April 30, 1903.)—A note on recent theories as to radium, in which the author suggests that the absence of change in the substance has been too hastily assumed. He considers that the atoms of radium are not stable under all conditions, and some pass into another configuration, giving out as they do so a large quantity of energy. J. J. S.

HEAT.

567. *The Black Body and Temperature Measurements.* **A. L. Day** and **C. E. van Orstrand.** (Astrophys. Journ. 19. pp. 1–40, Jan., 1904. Paper read before the Philosophical Society of Washington, Nov. 7, 1903.)—The name "black body" is now in general use to describe a *perfectly absorbing* body. It begins to emit light when the temperature reaches about 525° C. Its experimental study was commenced in 1895 by Wien and Lummer. They used a hollow sphere, coated on the inside with lampblack for low temperatures, and with oxide of iron or uranium for the higher temperatures. The sphere is provided with a single small opening. They showed that the Stefan-Boltzmann law, "The energy of completely diffuse (black) radiation is directly proportional to the fourth power of the absolute temperature," to be true. The generally accepted theoretical reasoning that has lead to this law is described. Further, the relations consequent upon Wien's theorem that with increasing temperature all wave-lengths are shortened in inverse ratio to the absolute temperature and Planck's law of distribution of energy in the black spectrum are discussed. After considering the general character and limitations of the radiation function, the question whether the temperature of the sun or of inaccessible volcanic openings can be measured, with the help of the above laws, is examined. It is shown that up to 2,000°C. the laws of the black body enable temperature to be estimated with an accuracy of 10 per cent. Applied to the solar temperature these laws give a much lower value—about 6,000° C.—when compared with the older estimates. Using the same methods, the temperature of the electric arc is about 4,000° C. The article is a convenient summary of the theory and practice of this new method of high-temperature research. W. W. H. G.

568. *Comparison of Calorimeters.* **J. S. S. Brame** and **W. A. Cowan.** (Soc. Chem. Ind., Journ. 22. pp. 1230–1233, Nov. 30, 1903.)—An investigation is made of the calorific powers of various coals, using several well-known calorimeters in each case. Previous comparative work has shown great differences in the results for the same coal when treated in the different calorimeters. The Lewis Thompson calorimeter is found to give great errors on account of the coal which remains unburnt. The W. Thomson and the Fischer calorimeters are also condemned from the results obtained. The Mahler bomb-calorimeter is recommended as much superior to the other kinds mentioned above, but is expensive, and is not suited to the rough and ready determination of shop practice. Curves show that it gives greater calorific power than other calorimeters for each coal tried. P. E. S.

569. *Difference of Temperature of Bodies in Contact.* **E. Rogowsky.** (Comptes Rendus, 137. pp. 1244–1246, Dec. 28, 1903.)—Since two bodies of different natures have, when in contact, different electrical potentials, it is to be expected that there may be a finite difference of temperature at their surface of contact. This would not be apparent when equilibrium exists, but might be observed when a flow of heat takes place through the interface. A current was passed through a silver wire in flowing water. A difference of temperature between the wire and the water in contact with it was always found to exist, which is in some cases as much as 25° C. J. E.-M.

570. *Integration of a Diffusion Equation.* **R. S. Woodward.** (Phys. Rev. 16. pp. 176–177, March, 1903. Abstract of a paper presented at the Meeting of the American Physical Society, April 21, 1902.)—To integrate the equation $\partial v/\partial t = a^2\partial^2 v/\partial x^2$, take another variable $z \equiv (q \pm x)/2a\sqrt{t}$, where q is an arbitrary constant distance, and assume that v is a function of z only; the equation then becomes $d^2v/dz^2 + 2z dv/dz = 0$, whence $v = A + C\int dz\, e^{-z^2}$. Thus, nx_0 being put for q, where n is an integer, a general solution is—

$$v = \sum_{n=0}^{n=\infty} \cdot \left\{ C_n \int_{nx_0/2a\sqrt{t}}^{(nx_0+x)/2a\sqrt{t}} dx\, e^{-x^2} + C'_n \int_{nx_0/2a\sqrt{t}}^{(nx_0-x)/2a\sqrt{t}} dx\, e^{-x^2} \right\},$$

where v is the excess at the time t of the temperature at x over that at $x=0$. [The author takes less generally $C'_n = -C_n$.] This result is then applied to the case of a sphere. R. E. B.

571. *Misuse of Physics by Biologists and Engineers.* **W. S. Franklin.** (Science, 18. pp. 641–657, Nov. 20, 1903. Paper read before the American Physical Society, Oct. 31, 1903,)—The author contends that the precise ideas and methods of thermodynamics are not unconditionally applicable to irreversible processes (which he calls *sweeps*) in general, but that they are precisely applicable to *steady* sweeps (*i.e.*, those irreversible processes which constitute permanently varying states, as in a slab with its faces kept at different temperatures), approximately applicable to those sweeps which involve either approximate states of thermal equilibrium or approximately permanent states of variation, and not applicable at all either to *simple* sweeps (*i.e.*, during the settling of a closed system to thermal equilibrium) or to *trailing* sweeps (*i.e.*, when a system tending to settle to equilibrium is subject to changing conditions which it never catches up); further, that temperature and entropy have no meaning as applied to elements of volume, so that they have no meaning in reference to irreversible processes. In illustration of his points he develops thermodynamics in terms of what he calls *thermodynamic degeneration* and *regeneration*, in which treatment there is nothing new, except that he insists that Clausius' inequality has no reference to any irreversible processes but steady sweeps. R. E. B.

572. *Clouding of Critical Solutions.* **D. Konowalow.** (Ann. d. Physik, 12. 5. pp. 1160–1164, Nov., 1903.)—A mixture of pentane and dichloracetic acid appears quite clear and transparent even at 0°, but when examined by Tyndall's method shows a very beautiful blue pencil of light, which is specially clear at 0°. The mixture is therefore an emulsion rather than a solution, and this conclusion is confirmed by the fact that the partial pressure of the pentane is almost independent of the proportion of acid over a wide range of composition. If M is the molecular percentage of dichloracetic acid, the partial-pressure of the acid is given by S in the following table:—

$t=0$	M = 0	S = 264·9	$t=18·1$	M = 0	S = 532·3
	25·05	247·5		32·8	505·3
	48·82	246·0		49·04	496·3
	65·34	243·6		65·6	484·3
	78·71	233·6		78·7	454·0

Thus at 0° an eight-fold increase in the proportion of acid only produces a decrease of 1·5 per cent. in the vapour-pressure of the pentane, which is reduced from 247·5 to 243·6 mm. The solution is near its critical point, and on cooling below 0° ultimately separates into two layers; the critical temperature is at — 7·5°; the critical solution contains rather more than 50 mol. per cent. of pentane, and in the neighbourhood of the critical temperature exhibits distinct opalescence. Below the critical temperature two liquid layers have the same vapour pressure, though a large difference in composition soon appears, but if the two layers are separated and heated above the critical temperature, no great difference in vapour pressure appears, in spite of the considerable difference of composition. The opalescence of the solutions in the neighbourhood of the critical temperature is ascribed to dust particles. [See also Abstract No. 1289 (1903).] T. M. L.

573. *Possible Forms of the Melting-point Curve for Binary Mixtures of Isomorphous Substances.* II. **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 244–259, Nov. 25, 1903. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Oct. 31, 1903.)—Nine diagrams are given to illustrate the possible forms of the melting-point curve for binary mixtures of isomorphous substances, and a mathematical discussion of the different cases is given. When the two substances are only partially miscible in the solid state, the curve usually resembles the familiar V-shaped curve of non-miscible substances, but may become modified so that the two arms of the V both slope upwards in the same direction, and it is even possible for one arm of the V to exhibit a minimum whilst the second arm has the normal form. When the miscibility is complete, the curve is usually a continuously ascending one, slightly concave in form, but the concavity is sometimes very greatly exaggerated, and may even develop into a well-marked minimum in the melting-point curve. [See also Abstract No. 322 (1904).] T. M. L.

REFERENCES.

574. *Cooling of Steel Rods by Bending.* **A. Wassmuth.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 578–590, April–June, 1903.)—In continuation of his former researches [see Abstract No. 1021 (1903)] the author shows that a cooling of measureable amount is produced by bending in the case of steel rods, and that the change in the modulus of elasticity can be determined by the comparison of theory and experimental results. G. W. DE T.

575. *Vapour-tension of Water below* 0° C. **K. Scheel.** (Deutsch. Phys. Gesell., Verh. 5. 17. pp. 287–290, Sept. 15, 1903.)—A comparison of the data of Regnault, Fischer, Jublin, and Marvin for water-vapour above ice and above water, below 0° C. A. D.

576. *Commercial Production of Oxygen from Liquid Air.* **E. C. Foster.** (Frank. Inst., Journ. 155. pp. 357–361, May, 1903.)—Liquid air is now being produced by a machine in Washington at the rate of from 12 to 18 gallons per hour with an expenditure of 150 h.p. This contains about 35 per cent. of oxygen initially, and evaporation to two-fifths bulk increases this percentage to 70, which is very suitable for medical purposes, the cost then being about 0·3 cent per cub. ft. of gas. R. E. B.

577. *Physical and "Natural" Equilibrium between the Modifications of Acetaldehyde.* **R. Hollmann.** (Zeitschr. Phys. Chem. 43. pp. 129–159, April 3, 1903.)—The author gives a complete concentration-temperature diagram for the two-component system, acetaldehyde-paraldehyde. The results illustrate Roozeboom's theory of the solidification of tautomeric mixtures. F. G. D.

578. *Kinetic Theory of Gases.* **H. Nagaoka.** (Nature, 69. pp. 79–80, Nov. 26, 1903.)—More approximate values for Maxwell's constants in his inverse-fifth-power theory than those given by Maxwell are $A_1 = 2{\cdot}6512$, $A_2 = 1{\cdot}3704$. R. E. B.

579. *On the Plaitpoints and the Corresponding Plaits in the Neighbourhood of the Border of van der Waals' ψ-surface.* **D. J. Korteweg.** (Archives Néerlandaises, 8. pp. 235–259, 1903.)—A mathematical discussion founded on the original equation given by van der Waals for the surface ψ. The paper is illustrated by a coloured plate. It forms a further contribution to the molecular theory of binary mixtures. [See Abstract No. 727 (1903).] F. G. D.

580. *Liquid State and the Equation of Condition.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 82–110, June 27, 1903.)—In this paper it is shown that, provided the hypotheses made at the outset by van der Waals (of constant values of *a*, and values of *b* varying with the volume) be maintained, the great departures observed will mostly disappear, the law of the dependence of *b* on the volume being presumed such as to give numerically correct data in many cases, even for the liquid state at low temperatures. A. G.

581. *Isothermals of Mixtures of Oxygen and Carbonic Acid.* **W. H. Keesom.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 401–414, Sept. 26, 1903.)—In this paper the author describes means of preparing mixtures in accurately known ratios, the determination of the compressibility of carbonic acid and some mixtures of carbonic acid and oxygen at ordinary pressures, and the results obtained. A. G.

582. *Influence of a Magnetic Field on Thermal Conductivity.* **A. Righi.** (Phil. Mag. 6. p. 725, Dec., 1903.)—Correction of a statement in Blyth's paper [see Abstract No. 114 (1904)]. R. E. B.

583. *Vapour Pressure of Ternary Mixtures.* **F. A. H. Schreinemakers.** (Archives Néerlandaises, 8. pp. 395–411, 1903. Translated from Zeit. Phys. Chem. 43. 671, 1903.)—This is a mathematical paper in which the author objects to certain conclusions as to the form of a particular curve arrived at by Ostwald (Abhandl. der K. Sächs. Gesell. d. Wiss. 25. 413, 1900) and published in the latter's well-known "Lehrbuch" (p. 1012). F. G. D.

584. *Exceptions to the Phase-rule, especially in Cases of Optically Active Substances.* **A. Byk.** (Zeitschr. Phys. Chem. 45. pp. 465–495, Nov. 3, 1903.)—The author maintains that cases such as that cited by van't Hoff, *i.e.*, the (apparently) 5-phase 2-component system—*i*-$NaClO_3$, *d*-$NaClO_3$, *l*-$NaClO_3$, solution, vapour—can be treated thermodynamically (as expounded by Planck), and do not form real exceptions to the phase-rule, provided a suitable definition be given of the term phase. The author does not agree with the (alleged) statement of Wegscheider [compare Abstract No. 336 (1904)] that such cases cannot be dealt with thermodynamically. F. G. D.

585. *Remarks on Byk's Paper.* **R. Wegscheider.** (Zeitschr. Phys. Chem. 45. pp. 697–699, Dec. 15, 1903.)—The author maintains that the difference of opinion between Byk and himself is of a purely formal nature. [See preceding Abstract.] F. G. D.

586. *Equilibrium between a Solid Body and a Fluid Phase, especially in the Neighbourhood of the Critical State.* Part I. and Part II. **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 230–244, Nov. 25, and pp. 357–366, Dec. 23, 1903. Translated from the Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Oct. 31, 1903.)—Mathematical papers dealing with the form of the curves and sections of the ψ-surface and the phenomenon of "retrograde solidification." F. G. D.

SOUND.

587. *Tuning-forks: Octaves and Asymmetry-tones.* **F. Lindig.** (Ann. d. Physik, 11. 1. pp. 31–53, April, 1903. From Kiel Dissertation, Part II.)—Two tuning-forks, nearly octaves to one another, sounding simultaneously on their resonance boxes, seem to wax and wane alternately: the suggested theories of this are discussed. The author finds that the lower tone remains constant while the upper waxes and wanes. The ground-tone of a tuning-fork is always accompanied by the octave, not due to longitudinal vibration or to changes in the volume of the prongs, but originated through want of symmetry in the air at the bounding surface between the prongs and the air. The phase of this octave-tone is all round the prongs, such that the pressure curve due to it and that due to the ground-tone coincide. The beats referred to are due to the composition of the sound of the smaller tuning-fork with the asymmetry-octave of the larger. No pure sinusoidal vibration can produce a pure tone; for the asymmetry-tones always intervene. [See also Abstract No. 1408 (1903).] A. D.

588. *Speaking Petroleum Lamps.* **A. Batschinski** and **V. Gabritschewski.** (Phys. Zeitschr. 4. pp. 403–404, April 15, 1903, Univ. Moscow. Also Ann. d. Physik, 11. 1. p. 223, April, 1903.)—In the primary circuit of an induction coil put a battery (for 4 amperes), a microphone, and a rheostat; connect the two terminals of the secondary coil with the flames of two Bunsen burners, petroleum lamps, or simple candles. The flames will sing or speak in accord with the microphone, and will do so more loudly if the flames be connected by a metallic wire. A. D.

589. *Sensitiveness of the Ear.* **P. Ostmann.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. pp. 340–346, Oct. 15, 1903.)—With Edelmann's tuning-forks, which remain audible for a very long time, ascertain from moment to moment the amplitude of vibration after a given initial displacement, and tabulate the data. Then ascertain at which instant the person whose ear is being tested ceases to hear the fork; the tables show the amplitude and, therefore, the proportionate intensity of the minimum audible sound. Comparison of the result with the data derived from normal ears gives the proportionate sensitiveness of the ear undergoing testing. The test is repeated with a series of forks of different pitches; and the amplitudes of the vibrations of these may be calculated when too small for micrometric measurement. More conveniently the required data may be obtained by measuring the time which elapses between the constant at which the patient and that at which the aurist ceases to hear the fork. Reference for fuller details to the author's "Eia objektives Hörmass," Bergmann, Wiesbaden, 1903. A. D.

590. *Effect of Magnetism on the Pitch of Tuning-forks.* **O. Kirstein.** (Phys. Zeitschr. 4. pp. 829–832, Nov. 15, 1903.)—The frequency increases when the plane of oscillation is at right angles to the magnetic field; and it does so the more rapidly with equal increases in the field strength, the stronger the field is at the time. When the plane of oscillation is parallel to the field, even moderate fields produce a powerful damping. In one intermediate position, at 45°, there is no effect. The alteration in the frequency is in both cases proportional to the field-strength, and the action is not a permanent one. A. D.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

591. *Motion of Electrons.* **K. Schwarzschild.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 5. pp. 245–278, 1903.)—An elaborate mathematical investigation of the motion of electrons which cannot even be outlined here. It must suffice to notice the following among the more important results obtained: (1) The equations of motion of electrons are analogous to those for rigid bodies in ordinary mechanics, but with the following notable exception. In the case of no external couple the vector of the rotational impulse is not fixed with respect to space, but fixed in the body of the electron. This inversion of the spinning-top problem when electrons are in question arises from the condition that the kinetic potential of an electron of given angular velocity depends upon an axis fixed in space, and not upon one movable with the electron. In other words, what may be termed the momental ellipsoid of the electron depends on the direction of velocity of translation of the electron, and does not turn with the body of the electron. (2) Uniform translation of the electron, combined with rotation about an axis fixed in space, is only possible if the axis of rotation is either coincident with or perpendicular to the direction of translation. (3) A free rotating electron, not subject to any external forces, does not move in a straight line as according to the ordinary law of inertia, but its middle point describes a cylindrical screw, and the body of the electron executes a regular precessing motion round the direction of the screw axis in such wise that the screw axis, the axis of rotation, and the direction of the middle point's velocity (in a corresponding parallel displacement) always fall in one plane. (4) If a rotating electron moves with the speed of translation of kathode or Becquerel rays in an electromagnetic field like that in Kaufmann's experiments, then it experiences not only forces of displacement but a couple also. An approximate evaluation shows that under the circumstances named the electron executes an ultra-microscopic screw motion about a middle line practically identical with that it would describe if not rotating. [See also Abstracts Nos. 1411 and 1416 (1903).] E. H. B.

592. *Electromagnetic Mass of Electrons.* **C. Runge.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse. 5. pp. 326–330, 1903.)—A criticism of Kaufmann's calculation of the value of ϵ/μ_0 from his experimental data. [See Abstract No. 1411 (1903).] The present author by following the usual method of least squares recalculates the value in question from Kaufmann's observations to be as follows: Mean value of $\epsilon/\mu_0 = (1{\cdot}755 \pm 0{\cdot}059) \times 10^7$.

E. H. B.

593. *Surface Discharges.* **J. de Kowalski.** (Comptes Rendus, 137. pp. 1246–1249, Dec. 28, 1903.)—A large plate of glass is covered on one side with tinfoil, and the other side is carefully polished. The tinfoil is attached to one terminal of a high-tension transformer, while at the centre of the other side is placed a point electrode in connection with the other terminal of the transformer. The diameter of the luminous discharge from the point is

found to vary directly with the voltage, attaining about 28 cm. with a voltage of 48,000. Further experiments show that if the tinfoil on the back of the glass be cut into patterns, the rays on the other side of the glass follow these, and that the glass is finally punctured at the outer limit of the tinfoil.

J. E.-M.

594. *Registration of the Electric State of Atmospheric Precipitations at Göttingen.* **H. Gerdien.** (Phys. Zeitschr. 4. pp. 837–842, Dec. 1, 1903. From Sitzungsberichte der Mathematisch-physikalischen Klasse der Kgl. Bayer. Akademie der Wissenschaften, 33. 2, 1903.)—A hut for the study of atmospheric electricity has been erected in summer, 1902, in a pine forest adjoining the geophysical institute at Göttingen. The hut is 2·1 m^2, 2 m. high, and overtopped by four rods, 1·7 m. high, supporting a wire cage. The author had apparatus constructed which photographically registers the atmospheric potential and the amount and electric discharge of the rain, snow, hail, &c., with the aid of a radium bromide collector and a quadrant-electrometer (amber insulation and desiccation by metallic sodium); a Benndorf electrometer further prints mechanical records at intervals of 10 minutes. The method of Elster and Geitel is employed. The author distinguishes steady, lasting precipitations, from squalls and thunderstorms; the fields reach respectively from 1,000 to 2,000 volts, 4,000 to 6,000, and 10,000 volts, the rain currents, intensities of 10^{-14}, 10^{-13}, 10^{-12} ampere/$cm.^2$; steady rains may be almost uncharged. The changes in the field potential and its sign, observed with all precipitations, are very rapid during thunderstorms; the rain may be charged in the same and in the opposite sense, and this circumstance is of influence for the speed with which the drops rush down. Taking the height of the clouds and also the field into consideration, the author concludes that the gravitational energy is more than sufficient to account for the electric display. He also confirms preliminarily C. T. R. Wilson's observation that the negative ions can particularly serve as condensation nuclei for the aqueous vapour in clouds.

H. B.

595. *Potential Gradient and Dispersion of Atmospheric Electricity.* **A. Gockel.** (Phys. Zeitschr. 4. pp. 871–876, Dec. 15, 1903.)—The diurnal dispersion-curve for positive and negative electricity, and also the curve for $q\ (a-/a+)$, run contrary to the humidity curve, and have two maxima (between 8 and 9 a.m. and about sunset), and a principal minimum at 4 a.m. Clouds have little influence provided there be no precipitation; the season does not change the form of the curve, but the values of q are high in winter. The rise in q is due chiefly to a decrease in $(a+)$. On the whole, q and the potential drop vary in the same sense, as the following numbers show, where P is the potential gradient in volts/m.:—

P up to	50,	100,	150,	200,	300,	400,	500,	600,	700.
q	1·12,	1·31,	1·69,	1·84,	3·2,	4·3,	5·46,	8·4,	9·07.

The figures from 200 volts upwards were observed on the Rothorn [see Abstract No. 1432 (1903)]. The depression in the potential about noon is probably connected with the air pressure. As soon as the mist begins to form in the evening, the potential drop grows, while $(a+)$ decreases, so that q also rises. The author insists upon the necessity of taking simultaneously electrical and meteorological observations; the ionisation and ionic mobility should also be determined.

H. B.

596. *The Noise of Lightning.* **J. Trowbridge.** (Scientific American, 89. p. 461, Dec. 19, 1903.)—This can be imitated with deafening results by means of a 6-ampere current and a transformer giving 2-in. sparks of great body when Leyden jars are used. The spark is taken across a gap of 4 in. between two pieces of wood saturated with distilled water and wrapped with cotton wool soaked with water. The noise is probably caused by the explosion of the hydrogen and oxygen gases produced by the dissociation of the water vapour ; and the noise of lightning appears to be enhanced by the presence of moisture in the clouds. The spectrum of the discharge is given. A. D.

DISCHARGE AND OSCILLATIONS.

597. *Conditions Controlling the Production of Electric Arcs.* **W. Mitkiewicz.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. 9b. pp. 675–697, 1903.) — The author has observed the so-called Edison effect (*i.e.*, the fact that negative electric charges are lost more rapidly from a heated body), between an incandescent carbon filament and a cold cylinder of the same substance, not only in the vacuum, but as well in hydrogen under atmospheric pressure. The current corresponding to a negative dispersion of electricity undergone by the wire proved 2,000 times stronger than the current of opposite direction (viz., about 0·4 ampere and 0·002 ampere respectively per sq. cm. of the surface of the wire). On this basis the hypothesis according to which electric arcs are made up of a flux of electrons issuing from the negative electrode becomes highly probable. The high temperature of the negative electrode of the arc is mainly due to the flux of heat issuing from other portions of the arc, which are at much higher temperatures. As regards the positive ions, the author thinks that they convey only relatively small amounts of energy to the negative electrode surface. Electric arcs will be produced quite spontaneously between two electrodes which do not touch one another, if their ends be brought to a white heat in a stream of oxygen. If the carbon electrodes be brought to a white incandescence by the action of the arc, and the current interrupted, and either of the electrodes be replaced by another electrode at the room temperature, the arc will only be produced spontaneously, without any contact, if the electrode which remains incandescent is the kathode. These experiments go to show the correctness of the hypothesis according to which a sufficiently high temperature of the kathode is the condition necessary for producing and maintaining the electric arc. On this hypothesis a large number of phenomena observed with electric arcs, especially in the case of a periodical extinction and restarting, may fairly well be accounted for. [See also Abstract No. 89 (1904).] A. G.

598. *Negative Dark Space, Primary and Secondary.* **J. Stark.** (Ann. d. Physik, 13. 2. pp. 375–393, Jan. 26, 1904.)—Two wires are fixed into a tube at right angles to the line of the discharge. On putting a potential difference on these, a secondary discharge takes place in which all the usual kathodic phenomena are observed. The features of the primary current which have any influence on this secondary discharge are examined, and an explanation based on the ionic theory is advanced. R. S. W.

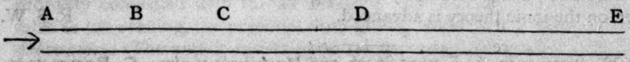
599. *Pressure in the Electric Spark and Magnitude of* e/m. **C. Baumgart.** (Phys. Zeitschr. 4. pp. 814–817, Nov. 1, 1903.)—Some years ago Dewar measured the pressure on the electrodes in an arc. By an extension of his method Mitkewitsch has determined v and e/m for the ions concerned in carrying the current. The method of the latter is here applied to the spark. There is found a pressure on each electrode. On the kathode this may reach 1 mm. of water; on the anode it is smaller and only appears under certain conditions. The pressure is greatest for short sparks. The mean value of v at the kathode appears to be about $1{\cdot}5 \times 10^8$, and e/m is equal to $1{\cdot}6 \times 10^5$.

R. S. W.

600. *Charges Produced by Röntgen Rays.* **A. Righi.** (Archives des Sciences, 16. pp. 612–613, Nov., 1903. Abstract from the Memorie R. Accademia delle Scienze dell' Istituto di Bologna, Series 5, vol. 10, May, 1903.)—The author describes the results of his observations on the comparative electric charges produced on various metals when Röntgen rays fall upon them. The charges for different metals are arranged in the following decreasing order: Platinum, lead, gold, amalgamated zinc, silver, tin, zinc, copper, iron, and aluminium. The conclusion is reached that the positive potential acquired by a metal struck by Röntgen rays depends not only on the nature of the conductor and on the state of rarefaction of the surrounding gas, &c., but also on the position which it occupies with regard to neighbouring conductors. The numerical values of this potential are thus only relative. There are great analogies between the phenomena produced by the ultraviolet rays and those produced by the Röntgen rays, but with notable differences in details. [See also next Abstract.]

J. J. S.

601. *Electrification by Gases Exposed to Röntgen Rays.* **J. Zeleny.** (Phys. Rev. 17. pp. 355–370, Nov., 1903.)—Röntgenised air which has been blown through tubes or rolls of metal foil is charged positively, so long as it retains any conductivity at all. The same tube or roll of metal foil, through which Röntgenised air is being blown, may receive a positive or a negative charge, depending upon the velocity of the stream of air. Under proper conditions the first part of a tube may receive a negative charge, while the more distant part of the same tube receives a positive charge. When moist carbonic acid is used, the charges developed in the gas and on the metal are the opposite to those obtained under like conditions with dry or moist air or dry carbonic acid. A general explanation for all of these results is found in ascribing their cause to the unequal velocities of diffusion of the two kinds of ions in the gas. Villari's hypothesis that the rubbing of the Röntgenised gas against a surface produces a separation of the two electricities, of which either may appear on the metal depending upon the amount of friction, is not sufficient to explain all of the facts, and is therefore untenable. When Röntgenised air is blown through an ebonite tube having a static charge on its inner surface, this charge is eventually all carried by the ions to the nearest conductor of large capacity against the gas stream. Villari's assumption that in such a case the charge vanishes, and that, in general, when Röntgenised air is changed into ordinary air this is done at the expense of an electric charge, is not upheld. The author's explanation is best understood from a purely theoretical case which he considers —



Suppose that A E represents a long, metal tube through which a gas is made to flow in the direction from A to E. Suppose, further, that the gas entering at A contains an equal number of oppositely charged and uniformly distributed ions, of which the negative are the smaller and consequently the more mobile. As the gas passes along the tube, the ions gradually disappear from it because of the re-combination of those of the opposite kind and because they discharge themselves when they come into contact with the walls of the tube. In the first part of the tube, the negative ions, being the more mobile, diffuse the more rapidly to the walls of the tube, giving it a negative charge, and leaving the gas itself charged positively. But as the gas passes along the tube, the preponderance of the negative ions reaching the walls gradually gets smaller, both on account of the relatively greater number of the positive ions remaining in the gas and because this excess of the positive gives rise to electrical forces that tend to drive them to the walls of the tube. There must be some point C, where the number of the two kinds of ions reaching the tube is the same. For all points to the right of C the positive ions get to the walls of the tube in excess, and some point E is finally reached where all of the ions have disappeared from the gas. The length of the tube required for this depends upon its cross-section and upon the velocity of the stream of air, increasing with both of these quantities. The gas issuing from the tube has lost its conductivity, and is electrically neutral. The tube as a whole does not become charged, as the amount of positive electricity received must equal the amount of the negative, since the gas entering and leaving the tube is assumed to be without a charge. A number of experimental modifications of this general hypothetical case are described in the paper. J. J. S.

602. *Ozonisation by the Silent Discharge in Siemens' Apparatus.* **A. W. Gray.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 46. pp. 1016–1020, Nov. 11, 1903.)—The inner coating was connected through a make-and-break arrangement with a Leyden jar kept at a constant potential by a Voss machine, while the outer coating was connected with earth. The ozone produced was small, and was estimated by absorption in sodium arsenite solution. The quantity of electricity, Q, which passed through the oxygen was ascertained from galvanometric measurements of the capacity C_v of the condenser during the experiment—

$$Q = \frac{10^{-11}\,Kl}{18 \text{ nat. log. } \frac{r_2}{r_1}} \cdot \frac{C_v - C_0}{C_0} \cdot V \text{ coulombs},$$

where K is the dielectric constant of the gas, l is the length of the condenser, r_1 and r_2 the radii of the glass tubes, C_0 the true capacity of the condenser, and V the potential of the inner coating. From the data it appears that the yield of ozone per coulomb of electricity is independent of the difference of potential between the coatings, probably also of the strength of the current; this is in accordance with the technological practice of using as small a potential difference as possible. D. H. J.

603. *Ozonisation by the Silent Discharge.* **E. Warburg.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 46. pp. 1011–1015, Nov. 11, 1903.)—The author has determined the amount of zone produced by the silent discharge of one coulomb of electricity from a metal point (kept at constant potential) to earth electrodes of different forms. The current of oxygen to be ozonised was drawn past the point and then into standard sodium arsenite, in order to estimate the ozone produced. It was found that whether the point was positively or negatively electrified, the quantity of ozone per coulomb was independent of the form of the earth electrode to which discharge took place, and depended only on the current strength. The increase in the yield with increasing current strength was more marked when the point was positively electrified. At best, however, the yield is only ¼ or ⅕ of that obtained per coulomb in a Siemen's tube. The ozonisation of oxygen is not to be explained as an electrolytic phenomenon, since it is found that for the production of one gram-equivalent of ozone, from 92 to 500 coulombs only are needed, whereas for the electrolytic separation of the same quantity of ozone 96,540 coulombs would be necessary. The ozonisation is ascribed by the author to kathodic and ultraviolet rays. D. H. J.

604. *The Mercury Arc.* **de Valbreuze.** (Comptes Rendus, 137. pp. 912–913, Nov. 30, 1903.)—The normal appearance of the anode is a uniformly luminous plane—but at times very bright stars appear setting themselves in regular patterns, often pentagon or hexagon. The explanation given is that there exists a surface film on the mercury more or less permeable to the current, and this film acquires at times a state of vibration causing the regular figures. P. E. S.

605. *Electrical Discharge in Mixtures of Gases.* **K. Przibram.** (Phys. Zeitschr. 4. pp. 842–845, Dec. 1, 1903.)—On continuing to experiment on the discharge in CO_2 and air [see Abstract No. 2448 (1900)] between a platinum point and an aluminium plane, the potential difference for discharge was found to be 5,200 volts in CO_2 and 4,400 volts in air for a 5 mm. spark when the point is positive, and 3,500 and 3,700 when the point is negative. When a small amount of CO_2 is added to the air, the discharge changes from a spark discharge to a faintly luminous steady stream, the potential difference falling by 200 to 300 volts. If more than a trace of CO_2 is added, the potential rises according to an approximately straight line law until the composition of the mixture reaches 100 per cent. CO_2. When the point is negative, however, a fall in potential difference begins when the pressure of CO_2 reaches 600 mm., that of the air being 160 mm. Mixtures of CO_2, Cl_2, CO_1, NH_3, and H_2S with air were examined, and it was found that for a trace of the substance the potential difference fell below that for either pure air or the pure substance. In mixtures of N_2 with H_2 and of Cl_2 with CO_2 the effect could not be observed. Many organic compounds were observed to exhibit the phenomenon. The presence of traces of two different substances produces a different effect to the presence of the substances separately. If the stream or brush be produced with CO_2 in air, and an amount of Cl_2 admitted which by itself would be effective, the stream disappears. S. G. S.

606. *Conductivity of the Air Produced by Waterfalls.* **K. Kaehler.** (Ann. d. Physik, 12. 5. pp. 1119–1141, Nov., 1903. Extract from the Kieler Inaugural Dissertation.)—The object of the investigation described was to inquire into the electrification excited in air by the falling through it of water and common salt solution, and especially, by the determination of the migration velocity of the carriers of electricity in it, to obtain some deduction as to the nature of these carriers produced by the motion of the fluid surfaces. The results arrived at are: For air electrified by means of distilled water pure unipolar conduction was proved. The migration velocity of the negative carriers of electricity in it corresponds in its order of magnitude with the earlier

measurements of the conductivity of air made in other cases. On the other hand, in air electrified through salt solution both kinds of ions were observed. The positive travel with extraordinary slowness, the negative as quickly as those produced by means of distilled water. Other researches lead to the hypothesis that the negative ions contained in air electrified by solution of NaCl originate only in a secondary way, and are continually produced afresh in the air. J. J. S.

607. *Stratified Discharges in Hydrogen at Atmospheric Pressure.* **C. Stuchtey.** (Phys. Zeitschr. 4. p. 871, Dec. 15, 1903.)—A description of the apparatus by which stratified discharges similar to those obtained in Geissler tubes were got at atmospheric pressure in hydrogen, with photographs of some of the discharges. The currents used varied from 20 to 40 milliamperes, and the distance between the electrodes from 7/6 to 27/6 mm. The stratifications are convex towards the kathode and broaden out as their distance from the anode increases, while at the same time the interval between them becomes greater. J. J. S.

608. *Ionisation of Air Produced by an Electrified Point.* **A. Righi.** (Journ. de Physique, 2. pp. 909–913, Dec., 1903. R. Accad. d. Sc. d. Istituto di Bologna, 10 pp. 371–391, 1903.)—Through the movement along the lines of force of electrified particles sent out from a point it is possible to get the electric shadow on a screen of an interposed object. There is a continuous ionisation of the molecules of air in the neighbourhood of the point. The ions possess sufficient kinetic energy to ionise the molecules of air in their path. The convection along the lines of force is not effected by electrified molecules of air but by ions with a charge similar to that on the point. Sometimes the ions may leave a highly curved line of force moving along a tangent to it into a region where there is no field of force. Thus there may be a point giving a continuous output of electricity in the interior of a metal box joined to earth, an opening in the box opposite the point being closed by a metallic gauze. The lines of force end on the box and on the boundaries of the meshes of the gauze, where they curve slightly. Under these conditions the ions may escape through the openings of the gauze into the region of zero field outside, where they may charge a disc fixed opposite the gauze and joined to an electrometer. If S be the electrometer deflection corresponding to 1 volt, and δ the deviation observed after exposure of the disc, of capacity c, to the flux of the ions for a time t, the strength of the current produced by the ionisation is given by $i=\frac{\delta c}{tS}$. Thus it can be proved that (1) the disc becomes charged with electricity of the same sign as that on the point, which shows the passage of ions across the gauze, moreover the charge is greater (other circumstances being the same) when the charge is negative than when it is positive; (2) that when the distance d from the gauze to the disc is increased, i increases at first and then diminishes, this being due to the fact that the field in the metal box in which the disc is placed does not remain zero but increases owing to the charge gained by the disc; its increase causes an opposition to the arrival of the ions, which diminishes i in proportion as d is small. When d has a considerable value this perturbation is scarcely felt, and i diminishes conformably to theory. The author describes experiments which he has carried out to verify this explanation. J. J. S.

609. *Rate of Recombination of Ions in Air.* **R. K. McClung.** (Phil. Mag. 6. pp. 655–666, Dec., 1903.)—Rutherford has investigated the rate of recombination of ions in gases at the ordinary temperature and pressure of the surrounding air, and he verified the equation $dn/dt = -an^2$, representing the law of recombination of the gaseous ions. The author, who previously studied the relation between the pressure of the air and the rate of recombination [see Abstract No. 1350 (1902)], here describes experiments designed to find the effect of change of temperature on this rate. The air was ionised by Röntgen rays, and the following are the results obtained: (1) The law stated above represents the rate of recombination for temperatures between 15° C. and 300° C. (2) A rise in the temperature of the air causes a considerable increase in the value of the coefficient of recombination, and the relation between the temperature and this coefficient does not appear to be a very simple one. J. J. S.

610. *Ionisation by Phosphorus.* **E. Bloch.** (Comptes Rendus, 137. pp. 1040–1042, Dec. 14, 1903.)—Referring to his former paper [see Abstract No. 1050 (1903)], and the adverse criticism of G. C. Schmidt [see Abstract No. 85 (1904)], the author brings forward some new facts with the object of confirming his own hypothesis that there are true ions in the emanation from phosphorus, though these have very slight mobility. The independent measurements of the mobilities, of the coefficients of recombination, and of the ratio $\epsilon = \frac{a}{4\pi(k_1 + k_2)}$ (where a is the coefficient of recombination and k_1, k_2 the mobilities of the ions), furnish a set of concordant results which the author considers prove the existence of a true ionisation. J. J. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

611. *Alternating-Current Galvanometer for Comparing Capacities, &c.* **W. Stroud** and **J. H. Oates.** (Phil. Mag. 6. pp. 707–720, Dec., 1903.)—This instrument consists of a d'Arsonval galvanometer, having, instead of the usual permanent magnet, a laminated iron electromagnet excited by means of alternating currents. The authors show how it may be used to compare capacities ranging from 1 microfarad down to a micro-microfarad, and inductances from a henry down to a micro-henry, with such sensitiveness that they think "v" might be determined with considerable accuracy by its aid. Bridge methods were used, in which the moving coil was connected across the ratio arms without a key, the bridge and magnet-coils being connected in parallel to the alternating supply. For the comparison of capacities the method of De Sauty was used, in which capacities in the ratio arms are compared by adjusting resistances in the other two arms until balance is obtained. Inductances were measured by comparison with capacities according to a slight modification of Anderson's method (Electrician, 27. p. 10, 1891). J. D. C.

612. *Grouping of Cells to obtain Maximum Current.* **E. D. Pierce, W. J. Humphreys,** and **K. E. Guthe.** (Elect. World and Engineer, 42. pp. 559–560, Oct. 3; p. 674, Oct. 24; and pp. 955–956, Dec. 12, 1903.)—The first two of these articles, by Pierce and Humphreys respectively, merely contain mathematical proofs of the rule, that to obtain a maximum current from a given number of similar cells to be arranged in simple series parallel groups, the cells must be so arranged that their combined internal resistance is equal to the external resistance in circuit. Guthe shows that the more correct rule is that the *ratio* of the internal resistance to the external resistance should be as nearly as possible equal to unity. Then following Wassmuth (Carl's "Repertorium der Physik," 1878, p. 586), he shows how to arrange a given number of cells to obtain maximum current, when they are divided into sets connected in series, but not, in general, containing the same number in parallel. J. D. C.

613. *Influence of Illumination on the Conductivity of Selenium.* **N. Hesehus.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 9b. pp. 661–664, 1903.)—From the formula $i=a(b^m-1)=a(a_1m+a_2m^2+a_3m^3+\ldots)$, given by the author in 1883, the relation $\frac{m'}{m}=\frac{1g(i'+a)-1ga}{1g(i+a)-1ga}$ may be derived. Supposing, for instance, the intensities of illumination to be $i'=4i$; it is found that the relation m'/m of the alterations of the conductivity must take values variable between 4 (for $i=0$) and 1 (for $i=\infty$). This conclusion is borne out by previous experiments by the author. The experiments of Hopius, discussed in this paper, are another instance of the correctness of the above law, it being shown from the results that the ratio m'/m decreases from 1·7 down to 1·3 with increasing intensity of illumination, though Hopius derives from his experiments the law $m=(ai)^{1/3}$, whence the constant value $1{\cdot}6=(4)^{1/3}$ would be inferred for m'/m. A. G.

614. *Influence of Certain Substances on the Electrical Resistance of Selenium.* **A. B. Griffiths.** (Comptes Rendus, 137. p. 647, Oct. 27, 1903.)—The author in measuring the resistance of selenium by the Wheatstone bridge method found that certain animal and vegetable pigments produced a diminution in the resistance when the selenium was exposed to their effects for fifteen minutes at a distance of 5 cm. The following show the values of this change :—

	Resistance of the Selenium.	
Pigments.	Before exposure. Ohms.	After exposure. Ohms.
Verbena petals	340,000	290,000
Helianthus petals	420,000	415,000
Geranium petals	462,000	320,000
Bacterium Allii	390,000	370,000
Pélagéine	350,000	330,000
Diemyctyline	444,000	410,000
Amanitine	380,000	360,000

Light, radium rays, and the Röntgen rays diminish the resistance of selenium (erroneously described as the "resistance of radium" in the article). The author thinks it possible that these pigments emit these rays. Edison has already shown that chlorophyll, curcumarin, and daturin produce phosphorescence. L. H. W.

615. *Electrostatic Capacity of Tubes filled with Exhausted Gases.* **A. Afanassieff** and **E. Lopuchin.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 8b. pp. 617–634, 1904.)—In recent experiments on a tube of exhausted air, connected by means of one of its electrodes to one of the terminals of a spark-coil, the authors obtained the following results: (1) The electro-

static capacity of the tube after first increasing with decreasing pressures of the gas contained therein, reaches a maximum corresponding to a tension of 1 mm. of mercury, diminishing again for pressures below that value. (2) The alterations in the capacity are accompanied by alterations in the volume of the luminescent portion of the tube, as well as in the character of the luminous phenomena. (3) The capacity of the tube increases with the electric potential imparted to its electrode. (4) The capacity increases also as the frequency of the interruptions of the primary circuit increases. (5) At pressures less than 1 mm. of mercury a longitudinal magnetic field lowers the capacity of the latter. (6) A transverse magnetic field increases the capacity at pressures intermediate between 25 mm. and 1 mm.; at the pressure 0·5 mm. it has no effect, but at still lower pressures it causes a diminution in the capacity, an increase being again observed for pressures below 0·03 mm. A. G.

616. *Mobile Conductors.* **C. Christiansen.** (Ann. d. Physik, 12. 5. pp. 1072–1079, Nov., 1903.)—The author describes some interesting modifications and extensions of experiments relating to electro-capillary phenomena (*cf.* Liquid Coherers and Mobile Conductors, Phil. Mag., May, 1897). A photographic dish 10 × 4·5 cm., and say 4 cm. high, preferably of glass, forms the electrolytic cell. It is provided with a watch-glass containing a large globule of mercury. Into this cell is poured 45 c.cm. of a 1 per cent. normal solution of KNO_3, which completely covers the watch-glass and the mercury. Two platinum electrodes are provided, one at each end of the cell, outside the watch-glass. When there is no current the globule, as viewed from above, is circular. With 0·01 ampere the globule becomes approximately oval, the direction of the current being from the narrow to the blunt end of the oval. With 0·02 ampere the narrow end becomes more pointed, and at the same time, between the narrow end and the median section of the globule, there forms a protuberance, so that the appearance from above resembles an oval with a somewhat pointed cap on the narrow end, the projecting rim of the cap constituting the protuberance. With 0·03 ampere the narrow end becomes rounder, and the protuberance more decided. With 0·033 ampere the globule becomes extended, and a neck forms between the protuberance and the narrow end, much as though it were there encompassed with an elastic ring, tending to divide the globule into two. When the current is further increased, separation does occur at this place. The author, following Lippmann and v. Helmholtz, assumes the existence of an "electrical double layer" between the mercury and the electrolyte, the positive layer being generally towards the mercury. This initial distribution of charges is described as "self-polarisation." The phenomena of movement of the globule are explained by tracing the effect of superposing "electrolytic polarisation" upon the "self-polarised" globule. For example, suppose the electrolytic current to traverse the surface of the globule from a point A to B. At A positive electricity appears at the outer, and negative at the inner "layer"—consequently the surface-tension of A is increased. At B the surface-tension is lessened. Mercury therefore flows from B towards A at the surface, and from A to B within the globule. Simultaneously the contact-film of electrolyte is carried over the surface of the globule in a direction opposed to that of the electrolytic current. In order to compare the magnitudes of the effects with various electrolytes, the author arranged a straight glass tube, with bent-up ends, to contain the electrolyte. A small globule of mercury is placed within the tube so as to lie at about the middle when the

tube is horizontal. The level of the tube can be adjusted by means of a wedge. The measurement consists in observing the angle the tube makes with the horizon when the globule is in equilibrium for a given current and a given electrolyte. With potassic cyanide there is a curious reversal of this movement when the current exceeds a certain critical value. Another attempt at numerical results was made by observing the behaviour of mercury falling in drops in an electrolyte. A current was passed through the electrolyte by means of vertical platinum electrodes, fixed clear of the mercury, one on each side of the jet. The effect of the current is to deflect the stream of globules towards one or other of the electrodes. The extent of the deflection is noted for various electrolytes, for various concentrations, and for gradually increasing currents. When pure mercury is contaminated with zinc, reversals occur at the moment that the amalgam arrives at the jet. According to Nernst, zinc amalgam gives positive ions to the solution, and itself becomes negative—*i.e.*, the self-polarisation of zinc amalgam is negative—which explains the reversal. In zinc sulphate there is little or no deflection with zinc amalgam drops. It is suggested that in this case there is no "self-polarisation." R. A.

617. *Radium Radiation and Contact Electricity.* **Blythswood** and **H. S. Allen.** (Phil. Mag. 6. pp. 701–707, Dec., 1903.)—The difference of potential established between two metal plates when the air between is subject to the influence of radiations from a radium salt was measured by means of a Kelvin quadrant electrometer. In the second series of observations taken, the whole apparatus was made of lead, and measurements of the potential difference between lead and any one metal were obtained. This arrangement was convenient, as the apparatus and the radium salt had in any case to be enclosed in lead for screening purposes, and, moreover, lead is at one end of the voltaic series. The following are the potential differences observed when the lower electrode, on which the metal tested was placed, was joined to the insulated quadrants, while the upper electrode (whose distance from the lower could be adjusted) was joined to earth.

Metal.	Potential.	Metal.	Potential.	Metal.	Potential.
Zinc	—0·15	Antimony	+0·16	Silver	+0·33
Aluminium	—0·14	Brass	+0·23	Gold	+0·36
Tin	+0·07	Iron	+0·23	Platinum	+0·40
Bismuth	+0·11	Copper	+0·25		

The plates of metal employed were commercial specimens and not chemically pure. The numbers obtained are relative, and the order of the metals is the same as in the voltaic series. The numbers are of the same order of magnitude as is obtained by connecting the metal plates with a drop of water. No measurable alteration was obtained when the P.D. was observed in an exhausted vessel, the readings being the same after the admission of dry air. It was estimated that an alteration of 5 per cent. could be detected. J. J. S.

618. *Contact Resistance.* **A. Blanc.** (Comptes Rendus, 137. pp. 1042–1044, Dec. 14, 1903.)—The resistance studied was that of a coherer formed of a plane of steel and a ball of steel, the surfaces of which were carefully polished. A contact resistance has a nature very different from that of a metallic resistance. It is a *reversible* function of the strength of the current

whenever it is not in process of changing through the effect of the passage of the current. It experiences besides an *irreversible* diminution whenever it is traversed by a sufficient current during an appreciable time. This last phenomenon depends on the direction of the current. J. J. S.

619. *Conductivity of Mercury Vapour.* **P. C. Hewitt.** (Elect. World and Engineer, 42. pp. 1000–1002, Dec. 19, 1903.)—Two platinum-rhodium thermo-junctions were sealed into the glass tube containing the mercury vapour, at a measured distance apart. These served the double purpose of measuring the temperature and forming electrodes for determining the voltage drop per centimetre. The mercury vapour was presumed to be saturated, as there was always some liquid mercury in the tube. The results are given in the form of diagrams, of which perhaps the most important are the following:—

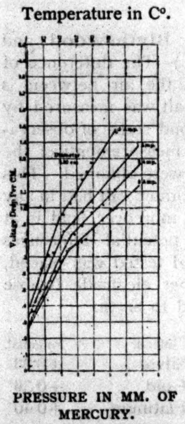
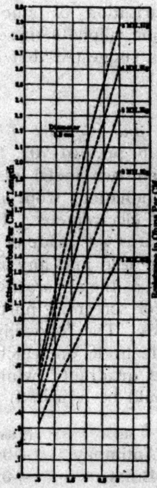
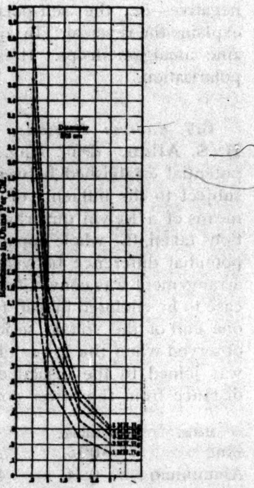


Diagram showing the Relation of Drop in Volts per cm. of Length to the Pressure in mm. of Mercury for Different Currents in Lamps of given Diameter.



Derived Curves showing the Relation between Watts absorbed per cm. of Length to Current in Amperes for Different Pressures of Mercury Vapour.



Derived Curves showing the Relation of Current in Amperes to the Resistance in ohms per cm. of Length for Different Pressures of Mercury Vapour.

J. E.-M.

620. *Conductivity of Mixtures of Electrolytes.* **F. Barmwater.** (Zeitschr. Phys. Chem. 45. pp. 557–565, Nov. 24, 1903.)—The author's previous work [see Abstract No. 1232 (1899)] deals with the conductivity of mixtures of strong electrolytes. The present paper deals with the so-called half-electrolytes, since mixtures of monovalent organic acids are studied. The chief difficulty hitherto in working out this problem has been the occurrence of equations containing several unknowns, which can only be solved by a tedious process of trial. Starting from the dissociation equation $\eta(1-y)=k\eta^2y^2$, where $\eta=$ the concentration, y the amount of dissociation, and k the dissociation constant, the author arrives at an equation which can be solved in

one or two trials. By measuring the conductivity of the sodium or potassium salts of acetic, glycollic, propionic, butyric, and valerianic acids at different degrees of dilution, the necessary constants were obtained. These were applied to the observed conductivities of the following mixtures in water: acetic and glycollic, acetic and propionic, acetic and butyric, acetic and valerianic, propionic and butyric, propionic and valerianic, valerianic and butyric. Comparing the results obtained with the calculated figures he finds that the agreement is very close for acetic and glycollic acids and fairly good for the remainder, with the exception of acetic and valerianic acids, in which cases the disagreement is most pronounced. F. S.

621. *Resistance Change due to Radiation.* **K. Regner.** (Phys. Zeitschr. 4. pp. 862–865, Dec. 15, 1903. Abstract of Greifswalder Dissertation, 1903.)—The resistance of thin layers of aqueous solutions of various salts is measured while the solutions are exposed to the action of ultra-violet rays, Röntgen rays, and kathode rays, the experimental results being in direct contradiction to those of Cunningham [see Abstract No. 165 (1903)]. No change of resistance amounting to 0·1 per cent. could be observed, nor could any change be detected in fluorescent liquids during fluorescence. G. E. A.

ALTERNATING CURRENTS AND MAGNETISM.

622. *Some Magnetic Alloys of Manganese.* **F. Heusler, W. Starck,** and **E. Haupt.** (Deutsch. Phys. Gesell., Verh. 5. 12. pp. 220–223, June 30, 1903.)—Taking an alloy of manganese and copper, free from iron and quite unmagnetic, the author mixes aluminium and finds increasing magnetic properties as the percentage of aluminium is increased. He also investigates the action on the alloys of varying temperatures and finds that high temperatures cause a disappearance of these magnetic powers. Manganese and aluminium without copper are also magnetic. It is interesting to observe in this connection that Wiedemann, Quincke, and others have shown that solutions of manganese salts are more magnetic than solution of iron salts. [See also next Abstract.] P. E. S.

623. *Magnetic Properties of Alloys of Manganese.* **W. Starck** and **E. Haupt.** (Deutsch. Phys. Gesell., Verh. 5. 12. pp. 224–232, June 30, 1903.)—A series of alloys of manganese, copper, and aluminium are used, in which manganese is always about 25 per cent., aluminium varies in different specimens from 3 to 14 per cent., and copper makes up the remainder. As aluminium increases, the permeability of the alloy increases. The field varies from 20–150 c.g.s. and the induction from 60–5,000 c.g.s. Heating for several hours at definite temperatures has a marked influence on permeability, as is shown in the tables given in the paper. [See also preceding Abstract.] P. E. S.

624. *Rotation in a Magnetic Field.* **K. Düsing.** (Ann. d. Physik, 12. 5. pp. 1158–1159, Nov., 1903.)—The author refers to the experiments of Hoppe [see Abstract No. 2239 (1902)], who found that the lines of force of a magnet rotating about its axis were dragged, to a slight but definite extent, after it. A similar effect is noticed by the author when a conductor (iron) is caused to rotate in an opposite direction in a magnetic field. A flat iron ring was placed between the poles, and a piece of paper, with iron filings sprinkled on

it, placed over these. At a certain strength of the field some leakage lines were observed in the central portion screened by the ring. On the ring then being rotated, the direction of these lines was deviated from the line joining the two poles, in the opposite direction to that of rotation. A photographic plate was strewed with the filings and exposed during the rotation. A distinct shifting of the lines was observable on the plate. From this the author concludes that in a fixed magnetic field also the lines of force are deviated in the direction of the rotation by the rotation of the substance conducting them. L. H. W.

625. *Magnetic Change of Resistance.* **W. E. Williams.** (Phil. Mag. 6. pp. 693–697, Dec., 1903.)—Load is applied to a wire whilst its resistance is measured and a strong field is applied to it longitudinally. The results depend on the metal chosen. *Nickel.*—Loading diminishes the change in resistance for low fields and increases it for high fields. Large residual effect of loading. *Iron.*—Loading has more pronounced effect for low fields than for high, but always produces diminution of change of resistance. But the effect of loading is much less in iron than in nickel, and the residual effect is almost inappreciable. *Platinite.*—This is a variety of invar. For low fields there is more effect than for high fields, but results are small and otherwise resemble those for iron. Temperature influences were also carefully tested. [See also Abstract No. 485 (1903).] P. E. S.

626. *Remarks on the Magnetic Storm of October* 31, 1903. **E. Marchand.** (Comptes Rendus, 137. pp. 789–792, Nov. 16, 1903.)—The extreme variation in the declination was at Bagnères (altitude 550 m.), 1° 15′, and on the Pic du Midi (2,860 m.), 1° 27·9′, photographic instruments of Mascart being used. A difference between the two observatories having always been observed with magnetic perturbations since 1895, the author concludes that the disturbing electric currents are, at least partly, situated in the higher strata of the atmosphere. He gives approximate estimates for the height of these currents, and recalls the fact that he suggested as early as 1887 a connection between increased solar activity—when faculæ and sun-spots cross the meridian—and magnetic storms; he regards the faculæ as the fundamental and the sun-spots as secondary phenomena. H. B.

627. *The Daily Field of Magnetic Disturbance.* **W. van Bemmelen.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 313–319, Nov. 25, 1903. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Oct. 31, 1903.)—Considering with Schmidt the magnetic disturbances to be caused by current rings somewhat analogous to Hildebrandsson's cyclonic movement of the atmosphere about the poles, the author argues that this system of circular currents should undergo a daily fluctuation by the rotation of the earth, and he had previously attempted to trace this fluctuation through the differences of corresponding hourly values on days following magnetic disturbances. In 1899 Lüdeling had obtained more distinct results by comparing the hourly values of the horizontal component on quiet days with those for all the days; in his vector diagrams the vectors moved, as a rule, anti-clockwise. The author has now studied the vertical components for the same period, June and July, 1883, for Greenwich, Washington, Tiflis, Zi-ka-Wei, Batavia, South Carolina, and Cape Hoorn, and he finds that the disturbing force acts in planes which cut the earth along curves converging to the pole of aurora borealis (80·5° N and 80° W), and that the daily movement of the arctic foci of disturbing force takes place in a circular path of 14·5° radius around a pole practically coinciding with the pole of aurora borealis, and lying very near the north end of the magnetic axis. If the disturbing force originate from electric currents, this system of currents would daily revolve with eight foci round the axis of disturbance, and the currents would, for the greater part, flow above the surface of the earth. H. B.

628. *Direction of Permanent Magnetisation in Volcanic Rocks.* **B. Brunhes** and **P. David.** (Comptes Rendus, 137. pp. 975–977, Dec. 7, 1903.)—On the Puy-de-Dôme, lava flowing over clay has transformed the clay, to a depth of 2 or 3 metres, into a kind of natural brick which is magnetic, while the lower strata only of the clay are susceptible of magnetisation. Declination and inclination measurements show that the direction of the magnetisation is more uniform in the brick than in the lava above, yet substantially the same in both, which would indicate that both strata have preserved the direction of the terrestrial magnetic field at the time of the lava discharge. In one spot a second layer of lava has been found at greater depth, and there the direction of magnetisation is not the same as in the upper layer. H. B.

629. *Stability of the Direction of the Magnetisation in Volcanic Rocks.* **P. David.** (Comptes Rendus, 138. pp. 41–42, Jan. 4, 1904.)—Stones of volcanic origin taken from an ancient Roman wall proved magnetic in various directions. Pieces of blocks from the Mercury Temple on the Puy-de-Dôme showed all approximately the same inclination, positive or negative, but differed strongly in declination. The author suggests that the directions of the magnetisation had not changed in the two thousand years, and that the blocks came from parallel layers of the same quarry, and that some were put in upside down; hence the change in the sign of the inclination. [See also preceding Abstract.] H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

630. *Inhibitory Action of the Constant Current on Strychnine Poisoning.* **A. Charpentier** and **T. Guilloz.** (Archives d'Él. Médicale, 12. pp. 69–71, Jan., 1904.)—Hydrochloride of strychnine in doses from 1/10 up to 2 milligrammes was injected subcutaneously into frogs, which were then subjected to the influence of a constant current of from 1 to 2 milliamperes. The current was applied either by means of electrodes saturated with salt solution placed on the belly and on the lumbar region, or by passing it through a vessel of water in which the frog was placed. Under these conditions the symptoms of strychnine poisoning are either almost completely inhibited, or, for the stronger doses, lessened in intensity. Tetanus supervenes a few minutes after the current is opened, to diminish or disappear again when it is closed. Life can be preserved after what would ordinarily be a fatal dose of strychnine, provided the application be sufficiently prolonged. The results are independent of the direction of the current, which was always passed transversely through the spinal cord. Further experiments lead the authors to believe that the poison undergoes some chemical or nutritive modification. Similar results were obtained with guinea-pigs. H. W. P. Y.

631. *Action of Röntgen Rays on Animal Tissues.* **R. Lépine** and **Boulud.** (Comptes Rendus, 138. pp. 65–67, Jan. 11, 1904.)—Portions of the pancreas removed from a fasting dog and exposed to Röntgen rays acquired a greater power of reducing sugar than other portions not so treated. Part of a dog's liver treated for less than an hour by the rays contained less glycogen and more sugar than the control. The sum of the glycogen and sugar was less. The first effect of the rays is to accelerate glycogenesis and glycolysis. If the exposure be longer than one hour, both the sugar and the glycogen are increased. The prolonged influence of the rays diminishes glycogenesis and glycolysis. In blood also there is first of all an acceleration, and, after prolonged treatment, a diminution of glycogenesis and glycolysis.

H. W. P. Y.

632. *Influence of Faradisation on the Functions of the Stomach.* **E. Cionini.** (Il Morgagni, Sept., 1903. Brit. Med. Journ. 2248. p. 19, Jan. 30, 1904.)—A dog, after fasting twenty-four hours, was treated with faradisation over the stomach. The organ was then opened and found to contain a thick yellowish fluid in which hydrochloric acid was present. Massage over the stomach of a fasting dog produced a similar result. The author concludes that the secretion of gastric juice obtained by faradisation is due to mechanical stimulation of the abdominal walls. To test the variations of pressure inside the stomach, he introduced into the organ, in man and dogs, a bladder filled with air, connected by a tube to an arrangement for recording changes of pressure on a revolving drum, a simultaneous record being made of the movements of the abdominal wall. Both records showed a series of waves closely resembling one another. On the application of the faradic current the rhythmical movements of the abdominal wall were interrupted or varied, the curve of intragastric pressure presenting very similar variations but of less degree. There was no indication of independent stimulation of the stomach walls. H. W. P. Y.

REFERENCES.

633. *Electromagnetic Theory.* **O. Heaviside.** (Electrician, 44. pp. 615–617, Feb. 23; 772–774, March 23; 920–921, April 20; 45. pp. 245–247, June 8; 445–448, July 13; 635–638, Aug. 17; 881–883, Oct. 5; 46. pp. 42–44, Nov. 2; 206–208, Nov. 30, 1900; 456–458, Jan. 18; 865–867, March 29; 47. pp. 83–85, May 10; 603–606, Aug. 9; 937–939, Oct. 11; 48. pp. 209–211, Nov. 29, 1901; 657–659, Feb. 14; and 49. pp. 267–269, June 6, 1902.)—A continuation of the series of articles on this subject [see Abstract No. 812 (1899)].

634. *Action of a Magnetic Field on the Mercury Lamp.* **J. Stark.** (Deutsch. Phys. Gesell., Verh. 5. 4. pp. 87–89, Feb. 28, 1903.)—The cluster of light at the kathode is moved to one side or the other of the tube according as a field across the tube acts directly or inversely. P. E. S.

635. *A Simple Oscillograph.* **A. Wehnelt.** (Deutsch. Phys. Gesell., Verh. 5. 8. pp. 178–183, April 30, 1903.)—A simple form of Duddell's well-known instrument.

P. E. S.

636. *Magnetic Manganese Alloys.* **F. Heusler.** (Deutsch. Phys. Gesell., Verh. 5. 12. p. 219, June 30, 1903. Paper read before the Archiv der Deutschen Physikalischen Gesellschaft, June 12, 1903.)—[See Abstracts Nos. 622 and 623 (1904).] P. E. S.

637. *A Convenient Galvanometer.* **W. P. White.** (Phys. Rev. 17. pp. 484–489, Dec., 1903.)—The author describes a galvanometer for elementary work capable of being easily constructed. It is of the reflecting type with a vertical astatic magnet system on the Weiss form. L. H. W.

638. *Permanent Magnets.* **F. Emde.** (Elektrotechn. Zeitschr. 24. p. 949, Nov. 12, 1903.)—The author discusses the magnetic energy in various cases. P. E. S.

639. *Magnetic Storm of October* 31, 1903. **T. Moureaux.** (Comptes Rendus, 137. pp. 705–706, Nov. 2, 1903.)—Brief account of the observations made in the Val Joyeux observatory by Itié. H. B.

640. *Magnetic Anomaly of the Paris Basin.* **T. Moureaux.** (Comptes Rendus, 137. pp. 918–920, Nov. 30, 1903.)—The observations taken at the 617 magnetic stations of France show many unexpected irregularities, particularly in the Paris Basin. The author has studied the magnetic elements of 130 stations, distributed over 12 departments, and he finds the conclusions drawn from a comparison of the declination, horizontal force, and vertical force, with regard to the position of the centres of attraction, confirmed by the observations of the total force. There may be magnetic rocks underneath the more recent strata. H. B.

641. *Norwegian Expedition to the Magnetic North Pole.* **R. Amundsen.** (Terrestrial Magnetism, 8. pp. 1–6, March, 1903. Paper read before the Gesellschaft für Erdkunde, Berlin, Dec., 1902.)—The author, a member of the Belgian expedition, intended to start in the summer of 1903 for a spot not too near the North Pole, probably Port Leopold, in North Somerset, and afterwards to move round the Pole, by sea and on land, in a circle of about 200 km. radius, finally returning *viâ* Alaska and Sitka. Absolute measurements are to be made with a Fox apparatus and a Wild-Eschenhagen earth inductor. H. B.

642. *Magnetic Storm of October* 31, 1903. (Nature, 69. p. 56, Nov. 19, 1903.)—Magnetic curves from the National Physical Laboratory are here reproduced. H. B.

643. *Magnetic Storm of October* 31, 1903. **C. Chree.** (Nature, 69. p. 6, Nov. 5, 1903.)—The magnetic storm began at Kew at 6 a.m., the horizontal force increasing suddenly by 60 γ; the total increase exceeded 750 γ. The storm was preceded by normal disturbances, and continued into November 1. [See also preceding Abstract.] H. B.

644. *Magnetic Elements on Jan.* 1, 1903, *at the Observatory of Val Joyeux.* **T. Moureaux.** (Comptes Rendus, 136. pp. 44–45, Jan. 5, 1903.)

645. *Röntgen Rays in Ophthalmic Work.* **M. S. Mayou.** (Roentgen Ray, Archives, 7. pp. 58–63, Jan., 1903.)—Paper on the use of Röntgen rays in localising foreign bodies in the eye, and on the treatment of rodent ulcer of the eyelids and of trachoma. A. D.

646. *Physiological Effects of Electricity.* **S. Leduc.** (Comptes Rendus, 135. pp. 878–879, Nov. 17, 1902.)—Previous experiments in inducing sleep continued and improvements introduced, getting rid of certain clonic contractions or convulsions by very gradually raising the potential during three to five minutes. [See Abstract No. 342 (1903).] A. D.

647. *Röntgen Rays in Cancer.* **J. Hall-Edwards.** (Roentgen Ray, Archives, 7. pp. 45–47; Discussion, pp. 47–48, Dec., 1902.)—In this paper very favourable results are reported, particularly in rodent ulcer and epithelioma and in suitable early cases of true cancer. A. D.

648. *Effect of Röntgen Rays on the Male Reproductive Organs in Animals.* **Albers-Schönberg.** (Revue Int. d'Électrothérapie, 13. p. 151, Nov., 1903.)—Experiments on rabbits and guinea-pigs show that prolonged exposure to the rays causes sterility in the male without loss of the sexual instinct. Microscopic examination post-mortem revealed the fact that the sterility was due to paucity and death of the spermatozoa. After a sufficiently long exposure these elements were entirely absent. H. W. P. Y.

649. *Cancer Treated by Röntgen Rays.* **L. Lejeune.** (Revue Int. d'Électrothérapie, 13. pp. 155–157, Nov., 1903.)—A case of recurrent cancer of the breast with secondary growths. Improvement under Röntgen-ray treatment, but subsequent fatal termination. H. W. P. Y.

650. *Treatment of Cancer by Röntgen Rays.* **Biraud.** (Comptes Rendus, 137. pp. 816–817, Nov. 16, 1903.)—An account of a successful case of inoperable cancer of the breast treated by radiotherapy, with details of the technique employed. H. W. P. Y.

651. *Cancer of the Larynx Successfully Treated by Röntgen Rays.* **Scheppegrell.** (Revue Int. d'Électrothérapie, 13. pp. 153–154, Nov., 1903. From Archives d'Él. Médicale.)—A case of laryngeal cancer, of well-established diagnosis, was subjected to daily exposures to the X-rays of 10 min. duration. At the end of three weeks the treatment was stopped, and six days later the general and local condition of the patient was considerably aggravated. This, however, quickly subsided, and a very well-marked improvement was observed. Treatment was then resumed, and at the end of another month the disease appeared to be completely cured; the growth had disappeared, and the ulceration of the vocal cord had cicatrised. H. W. P. Y.

652. *Theory of Siemens' Ozoniser.* **E. Warburg.** (Deutsch. Phys. Gesell., Verh. 5. 22. pp. 382–391, Nov. 30, 1903.)—The author discusses the theory of this apparatus in detail with formulæ and curves, for which the original paper must be consulted. S. R.

653. *Electric Convection.* **J. F. Meyer.** (Frank. Inst., Journ. 156. pp. 453–461, Dec., 1903.)—A historical summary with a bibliography, from the first experiments of Rowland to the recent joint work of Crémieu and Pender. W. S.

654. *Daily Variation in the Dispersion of Atmospheric Electricity.* **A. Gockel.** (Archives des Sciences, 17. pp. 93–100, Jan., 1904.)—This is a summary of the results of 600 observations made by the author in Switzerland, on Alpine mountains, in the desert, and on the shore of the Mediterranean, with special regard to the influence of humidity. [See also Abstracts Nos. 1423 (1903) and 595 (1904).] H. B.

655. *Measurement of the Resistance in Clinical Use of Constant Current.* **E. Castex.** (Archives d'Él. Médicale, 12. pp. 1–9, Dec., 1903.)—The resistance can be measured with the ordinary apparatus employed in electrotherapy provided that the voltmeter be placed in shunt in front of the milliamperemeter. The resistance of the voltmeter does not influence the exactitude of the results. The precision of the method will depend on the accuracy and sensibility of the galvanometer, but if this accuracy be defective, tables of corrections can be drawn up by testing with known resistances. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

656. *Liquid Cells.* **Berthelot.** (Annal. Chim. Phys. 27. pp. 145–271, Oct., and pp. 289–348, Nov., 1902.)—A lengthy series of papers dealing with the subjects referred to in Abstract No. 608 (1903). The author first discusses the calculation of e.m.f. from thermo-chemical data, drawing particular attention to entropy changes and to the difference between the measured heat changes and those really due to a given reaction. The chief subjects dealt with are as follows: Determination of smallest current which gives an *apparent* evolution of hydrogen in a voltameter; cells based on a simple reaction, such as that of an acid on a base; polarisation; cells based on interaction of oxidising and reducing agents; and cells based on complex reactions. The author finally gives twenty pages of conclusions, and discusses the bearing of his results on the physiological production of hydrochloric acid, &c. It is impossible to give a short abstract of the papers.
W. R. C.

657. *Atomic Weight of Lanthanum.* **H. C. Jones.** (Zeitschr. Anorg. Chem. 36. 1. pp. 92–100, July 23, 1903.)—When recently determining the atomic weight of lanthanum, Brauner and Pavlička obtained the value 139·04, differing from the figure given by the author by upwards of a quarter of a unit. The author therefore seeks the source of error responsible for the difference between two apparently equally accurate determinations. It is pointed out that in Brauner's work no mention is made as to careful spectroscopic examination of the material used, though such tests are particularly necessary in the case of rare earths. The author accordingly considers that he is warranted in assuming that Brauner's lanthanum contained at least some traces of impurities. Another point of some importance is a statement by Brauner to the effect that his material was not uniformly heated throughout its mass, so that the thermometer may have indicated a much lower temperature than the temperature of the external layer of lanthanum sulphate. The author has carried out some new determinations of the atomic weight in question, in which the average result, 138·80, showed a departure from the mean value of the former ten determinations, viz., 138·77, by a quantity not exceeding possible errors of observation. The author finally determined the atomic weight of lanthanum from oxide heated in platinum; the results obtained this way, in addition to being much higher than those previously found, differ to a noticeable degree according to the time during which the oxide has been heated in platinum, thus giving evidence of the lanthanum oxide having undergone a slight oxidation. This hypothesis was confirmed by placing some oxide, which had been kept glowing for some hours in platinum, in a porcelain vessel and heating it to the glowing point in a wide, hard glass tube in a stream of hydrogen, when the oxide suffered a loss in weight of 0·002 gm. per gm. of oxide in the course of one to two hours. These facts are sufficient to account for the differences between the author's and Brauner's results.
A. G.

658. *Reduction of Metal Oxides by Hydrogen.* **F. Glaser.** (Zeitschr. Anorg. Chem. 36. 1. pp. 1–36, July 23, 1903.)—An investigation into

the reduction of metal oxides in a stream of hydrogen has led to the following results: (1) The reduction of each metal oxide will begin at a practically definite temperature, the so-called reduction temperature. (2) In the case of there being several possible degrees of oxidation, the reduction of the highest degree will occur first; then, at a higher temperature, the next degree. (3) The reduction temperatures of the oxides of silver, mercury, copper, lead, cadmium, nickel, cobalt, iron, manganese, and zinc, and the conditions of reduction were determined. (4) The special action of hydrogen on the oxides of metals the affinity of which with regard to oxygen at ordinary temperatures is inferior to that of hydrogen, was investigated in the case of silver oxide, when a catalytic effect on the speed of reaction was shown to be impossible. The author accordingly assumes that the hydrogen will, in the reduction of silver oxide, unite with the oxygen atomically separated from the oxide. A. G.

659. *Classification of Colloids.* **A. Müller.** (Zeitschr. Anorg. Chem. 36. 3. pp. 340–345, Sept. 16, 1903.)—Recent experiments on the preparation and mechanism of colloidal solutions have shown essential differences to exist, as opposed to such analogies as would justify the classification of all these bodies in a common class of substances. This is best illustrated by the conditions of coagulation, or formation of the so-called *Gels.* Whereas colloidal solutions of hydroxides do not pass into their gels by heating, organic colloids, as is known, will either coagulate on being heated (albumenoids proper), or else cannot be made to coagulate by either heating or by additions of electrolytes. As metal and metal sulphide hydrosols are caused to coagulate by adding small amounts of any electrolyte (many analogies having shown these bodies to be suspensions of very small metallic particles in water), this coagulation should be regarded as a purely physical flocculation process. The heat coagulation of colloids, on the other hand, is due to purely chemical processes, the native albumin being converted into an acid albumin. The author therefore holds that these two groups of colloidal bodies constitute two essentially different groups. A. G.

660. *Colloidal Gold: Adsorption Phenomena and Allotropy.* **J. C. Blake.** (Amer. Journ. Sci. 16. pp. 381–387, Nov., 1903. From the Kent Chemical Laboratory of Yale University.)—Gold precipitated by barium compounds from colloidal solutions does not carry down any appreciable quantity of barium salt, whether the gold be obtained in the spongy or the blue form, nor are adsorption phenomena pronouncedly concerned, if at all, in the colour changes brought about in red gold solutions by electrolytes. [See also Abstract No. 688 (1904).] D. H. J.

661. *Colloidal Properties of Calcium Fluoride.* **E. Paternò** and **E. Mazzucchelli.** (Accad. Lincei, Atti, 12. pp. 420–428, Nov. 22, and pp. 520–528, Dec. 6, 1903.)—The tendency of calcium fluoride to assume the colloidal condition has been emphasised by Rose, but the subject has never been made a special study. The authors find that colloidal solutions of CaF_2 may be obtained by double decomposition between a soluble calcium salt and an alkali fluoride in dilute solution. The liquid has a slight opalescence, and even when it contains 3 gm. of fluoride per litre, may fail to give a deposit for months, and may require boiling for hours before all the colloid is precipitated. By dialysis the solution may be freed from crystalloids, and may then be concentrated over sulphuric acid, though not by heating.

Coagulation may be brought about by numerous electrolytes, which a list is given. In general it may be said that solutions of colloidal calcium fluoride have not that instability which characterises other colloids, and a relatively large quantity of the precipitant is needed to produce an immediate turbidity. Oxalic acid precipitates the calcium fluoride as such (not calcium oxalate), as do other (inorganic) acids, though ordinary calcium fluoride is somewhat soluble in acids. The calcium fluoride solutions which have not been dialysed behave towards precipitants in exactly the same way as the dialysed solutions. It has not been found possible to obtain the solid hydrosol. The authors have examined calorimetrically the formation of colloidal calcium fluoride by double decomposition in cases (*a*) where the fluoride remains dissolved, (*b*) where it is precipitated as hydrogel. The data show that the passage from dissolved hydrosol to precipitated hydrogel is attended by the evolution of heat, though they do not settle the question whether the passage from dissolved hydrosol to solid hydrosol is also exothermic. That we are dealing really with colloids in solution in cases where the calcium fluoride is not precipitated, and not with a condition where, *e.g.*, we have Ca- and -F_2 ions, is indicated by measurements of the electrical conductivity; the conductivity of such solutions is the same whatever the condition of the solution, whether limpid, opalescent, opaline, or turbid, so long as the concentration is the same, and this was found to be true for dilutions varying from 1 to 32.

D. H. J.

662. *Number of Independent Components of a System.* **V. Volterra.** (Accad. Lincei, Atti, 12. pp. 417–419, Nov. 22, 1903.)—The author gives a rule for calculating the number of independent components of a system, when applying the phase rule:—Let $P_1, P_2, \ldots\ldots\ldots P_n$ be the symbols of the elements which constitute the *m* bodies of the system, and let

$$\begin{array}{l}
P_1^{a'_1},\ P_1^{a'_2} \ldots\ldots\ldots P_n^{a'_n} \\
P_1^{a''_1},\ P_2^{a''_2} \ldots\ldots\ldots P_n^{a''_n} \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
P_1^{a^{(m)}_1},\ P_2^{a^{(m)}_2} \ldots\ldots\ldots P_n^{a^{(m)}_n}
\end{array}$$

be the chemical formulæ of the *m* compound bodies. Then if we put zero for the exponent of an element which does not enter into the composition of one of the bodies of the system, we have for the determinant—

$$\begin{vmatrix}
a'_1, & a'_2 & \ldots\ldots\ldots & a'_n \\
a''_1, & a''_2 & \ldots\ldots\ldots & a''_n \\
\ldots & \ldots & \ldots\ldots\ldots & \ldots \\
a^{(m)}_1, & a^{(m)}_2 & \ldots\ldots\ldots & a^{(m)}_n
\end{vmatrix}$$

Assuming that there are no subdeterminants of an order higher than *h*, or that they are equal to zero, then, if amongst the subdeterminants of order *h* there is one different from zero, *h* is the number of independent components of the system. The paper contains a number of simple illustrations of the rule.

D. H. J.

663. *Diffusion and Supersaturation in Gelatine.* **H. W. Morse** and **G. W. Pierce.** (Zeitschr. Phys. Chem. 45. pp. 589–607, Nov. 24, 1903.)—

R. E. Liesegang showed that if a drop of silver nitrate is placed on a gelatine film impregnated with potassium chromate, concentric rings of precipitated silver chromate are formed at increasing intervals as the silver nitrate diffuses outwards through the gelatine. Ostwald has shown that this phenomenon may be due to the gradual supersaturation of the gelatine and sudden precipitation of the silver chromate during the diffusion. By using a variation of this experiment, in which capillary tubes containing impregnated gelatine dip vertically beneath the surface of silver nitrate solution, the authors have investigated the problem as to whether the limit of supersaturation at which precipitation begins, in the absence of the solid phase, is defined by some constant ionic concentration-product $H = Ag^{2} \times CrO_4''$. The experiments were conducted in a dark-room, only illuminated when a reading was taken, and the data furnished by them were (1) the concentrations of the potassium chromate in the gelatine and of the aqueous silver nitrate solution, (2) temperature of the enclosure, (3) the time (t secs.) since the beginning of the experiment, of the formation of each layer of precipitate, which begins quite suddenly, (4) the distance (x) of each layer from the lower end of the capillary tube. With given conditions when $t = 0$, $x/\sqrt{t}$ was found to be constant, and by an application of the mathematical theory of diffusion, H was calculated and found to be approximately a constant with a mean value of $1{\cdot}4 \times 10^{-6}$ gm. mol. per litre; which shows that the concentration of silver chromate in gelatine at the limit of supersaturation is 145 times that for saturation in water in the presence of the solid phase, the solubility product of which is $5{\cdot}1 \times 10^{-13}$ according to Kohlrausch. The diffusion constant of silver nitrate in gelatine (containing the precipitate), determined by the authors from their observations, is 1·54 c.cm. per day, which is higher than that obtained in other ways. J. D. C.

664. *Scarlet Phosphorus, a New Chemically Active Variety of Red Phosphorus.* Part I., **W. Muir**; Part II., **R. Schenck** and **P. Marquart.** (Soc. Chem. Ind., Journ. 22. pp. 1225–1226; Discussion, pp. 1226–1227, Nov. 30, 1903.)—This substance appears to have been independently discovered by W. Muir and R. Schenck. It can be obtained as a bright scarlet powder by heating a 10 per cent. solution of white phosphorus in PBr_3 to boiling. It is not poisonous if swallowed, does not emit poisonous fumes, and has an ignition-point of about 170° C. It appears to be well adapted for the manufacture of non-poisonous, "strike-anywhere" matches. The real chemical nature of scarlet phosphorus does not appear to have been clearly ascertained as yet. On heating in an indifferent atmosphere PH_3 is evolved. In its behaviour towards HNO_3 and NaOH it resembles white rather than ordinary red phosphorus. Bases such as ammonia, dilute piperidine, &c., turn it black. The red colour is regenerated by acids. These combinations with bases appear to be the salts of a solid acidic polyphosphoretted hydrogen.

F. G. D.

665. *Composition of Bredig's Silver Hydrosols.* **J. C. Blake.** (Amer. Journ. Sci. 16. pp. 431–432, Dec., 1903. From the Kent Chemical Lab. of Yale University.)—The author shows that in preparing silver hydrosols according to Bredig's method of sparking between silver electrodes under water, the anode is corroded as well as the kathode, and silver compounds are formed as a by-product. It would seem essential that these facts should be taken into account in investigations such as those of McIntosh on the catalytic properties of the silver in hydrosols prepared in the above way.

D. H. J.

666. *Reaction between Phosphorus and Oxygen.* **E. J. Russell.** (Chem. Soc., Journ. 83. and 84. pp. 1263–1284, Dec., 1903.)—After a very careful kinetic investigation, both experimental and theoretical, the author comes to the following, amongst other, conclusions : (1) A small quantity of water is necessary for the reaction, but a greater amount retards the action considerably ; (2) moderately dried phosphorus and oxygen react under all ordinary pressures, the reaction occurring in two distinct stages ; (3) in moist oxygen the reaction does not begin until the pressure is $<$ 500 mm., and is then much retarded in its earlier stages. F. G. D.

667. *Action of a Mixture of Oxygen and Hydrochloric Acid on Certain Metals.* **C. Matignon.** (Comptes Rendus, 137. pp. 1051–1052, Dec. 14, 1903.)—In continuation of former experiments [see Abstract No. 126 (1903)], the author shows that a mixture of oxygen and hydrochloric acid acts on palladium, ruthenium, iridium, rhodium, and osmium with the formation of the respective chlorides. Palladium is rapidly attacked at ordinary temperatures. Ruthenium is only acted on slowly at ordinary temperature, but in a sealed tube at 125° C. the reaction is complete in a few hours. Iridium is not attacked at the ordinary temperature ; in a sealed tube at 150° the reaction proceeds vigorously. Rhodium is not attacked in the cold ; at 150° the reaction goes on slowly, but at 200° it proceeds rapidly. Osmium goes into solution at a temperature of 150°. T. S. P.

668. *Decomposition of Mercurous Chloride by Alkali Chlorides.* **J. Gewecke.** (Zeitschr. Phys. Chem. 45. pp. 684–696, Dec. 15, 1903.)—(1) The decomposition of calomel by alkali chlorides is largely dependent on the temperature and concentration, a rise in temperature and an increase in concentration causing a large increase in the amount of mercury taken up by the solution. (2) In concentration-cells with calomel electrodes and very dilute solutions (not exceeding 0·02 N) the decomposition of the mercurous chloride is not a source of error, but it is nevertheless advisable to keep the temperature as low as possible. (3) The action is increased by atmospheric oxygen. (4) In estimating mercury in the form of mercurous chloride it is necessary to precipitate at a low temperature and with a minimum amount of chloride.
T. M. L.

669. *Benzine Fluoride and some of its Derivatives.* **A. F. Holleman** and **J. W. Beekman.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 327–331, Dec. 23, 1903. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Nov. 28, 1903.)—The authors have prepared benzene fluoride by an improved method and accurately determined its physical constants, as well as those of several substituted benzene fluorides. The values obtained are as follows :—

	Melting-point.	Boiling-point.	Sp. gr. at 84°–48°.
m-nitrobenzene fluoride ...	1·7°	205°	1·2582
p-nitrobenzene fluoride ...	26·5°	205°	1·2583
p-aniline fluoride...............	—	187°	—
Nitraniline fluoride (1 : 2 : 4)	98°	—	—
Benzene fluoride...............	41·2°	85°	1·0236 (at 20°/4°)

Benzene fluoride, when treated with sodium in alcoholic solution, does not part with fluorine ; but the benzene nitro-fluorides readily react with sodium methylate, the *meta* and *para* compounds being quantitatively converted into the corresponding anisols. The velocity of interaction between benzene dinitrofluoride and sodium methylate was found to be about 600 times greater than in the case of the corresponding benzene dinitrochloride.

A. F.

670. *Suspensions in Media of High Viscosity.* **A. Müller.** (Ber. Deut. Chem. Gesell. 37. pp. 11–16, Jan., 1904.)—The following table shows the relationship between the viscosity of colloidal solutions and their gold-numbers as determined by Zsigmondy :—

		Viscosity.	Gold-number.
Gelatine	0·5 per cent.	1·443	0·005–0·01
Glue	„	1·213	0·005–0·01
Casein	„	1·182	0·01
Albumin I.	„	1·065	0·15–0·25
„ II.	„	1·052	
Gum	„	1·082	0·15–4
Tragacanth	„	1·201	About 2
Wheat-starch	„	1·043	4–6
Dextrin	„	1·028	6–20
Potato-starch	„	1.020	25
Cane-sugar	„	1·002	∞

With the exception of tragacanth and albumin, the gold-number increases steadily with the fluidity of the solution. The action of colloids in increasing the stability of suspensions of metallic gold is therefore due directly to the increase of viscosity. A similar protective action is observed on attempting to precipitate a viscous suspension by the addition of electrolytes. The following table shows the condition after 24 and 48 hours of an aqueous suspension of red phosphorus after adding an electrolyte and a colloid :—

Phosphorus Suspension.	Electrolyte.	Colloid.	After 24 hours.	After 48 hours.
50 c.cm.	5 c.cm. 10 p.c. NaCl	—	Very turbid	Very turbid
„	„	—	Clear	Clear
„	„	10 c.cm. 0·5 p.c. gelatine	Very turbid	Very turbid
„	„	5 c.cm. „ „	Turbid	Turbid
„	„	10 c.cm. 0·5 p.c. dextrine	„	Nearly clear
„	„	10 c.cm. 0·5 p.c. cane-sugar	Scarcely turbid	Clear
„	„	10 c.cm. 25 „ „	Very turbid	Turbid

The viscosity of the colloid thus protects the suspension against both gravitational and electrical forces. T. M. L.

671. *Action of Emulsin.* **R. O. Herzog.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 332–339, Dec. 23, 1903. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Nov. 28, 1903.)—The author shows that the velocity of most ferment actions can probably be represented by the equation $dx/dt=(k_1 \pm k_2x)(a-x)$ in accordance with the assumption of positive or negative catalytic action due to the substances formed. This equation, however, he considers incomplete, and gives it the form $dx/dt=(k_1 \pm k_2x)(a-x)b$, where a is the concentration of substance being inverted, *b* that of the ferment. The fraction ak_2/k_1 remains practically constant, and hence $a/\alpha = k_1/k_2/\gamma_1/\gamma_2$, in which a and α represent the concentrations of the substances undergoing inversion, k_1 and k_2, γ_1 and γ_2 the corresponding velocity constants. The author does not accept the formulation given by Henri. A. F.

672. *Phenomena of Solidification and Conversion in the Systems NH_4NO_3, $AgNO_3$ and KNO_3, $AgNO_3$.* **H. W. Bakhuis Roozeboom.** (Konink. Akad. Wetensch. Amsterdam. Versl. 12. pp. 358–361, Sept. 26, 1903.)—Of the nitrates of monovalent elements, those of Li, Na, Ag, NH_4, K, Tl have been more especially investigated in their mutual connection, it being shown that the nitrates of the first three will give within a very wide range mixture crystals with one another, the same being also true of the last three. The present research is an extension of these investigations. It is shown that at ordinary temperatures, only the simple salts, in their forms corresponding with the temperature concerned, can occur as stable states besides the double salts 1 : 1. A. G.

673. *Solubility of Phosphorus in Carbon Disulphide and in Benzene.* **H. Giran.** (Journ. de Physique, 2. pp. 807–809, Nov., 1903.)—The results are as follows :—

(1) In CS_2.

Temperature	—79°	—49°	—23°	—19°	—14°	—9°	—3°·5	—2°	0	3°	14°·5	25°
Solubility ...	4·6	9·5	19·1	21·1	22·4	30·9	66·8	75·8	83·6	84·8	89·2	92·8

(2) In C_6H_6.

Temperature	18°	36°	58°	70°	81°	99°	115°
Solubility	2·0	4·2	6·4	7·7	9·1	4·1	12·4

F. G. D.

674. *Colloidal Solutions.* **G. Quincke.** (Ann. d. Physik, 12. 5. pp. 1165–1168, Nov., 1903.)—In reply to Bredig [see Abstract No. 429 (1904)], who considers that colloidal solutions are heterogeneous two-phase systems, it is urged (1) that polarisation of the diffused light is produced by particles floating in a gas or liquid in the same irregular manner as in a colloidal solution, without the occurrence of any regular two-phase system ; (2) that colloidal "solutions" produced by suspended metallic particles are not comparable with solutions of the ordinary organic and inorganic colloids ; (3) that there is sufficient evidence to show that the particles of a very fine suspension exhibit the properties of liquids rather than those of solids. T. M. L.

675. *Pyrogenic Reactions by means of the Electric Current.* **W. Löb.** (Zeitschr. Elektrochem. 9. pp. 903–908, Nov. 12, 1903.)—By subjecting the vapours of benzylchloride, benzalchloride, and benzotrichloride to the decomposing action of a glowing platinum spiral the author obtains various products whose formation can be explained by assuming the production of intermediate unsaturated dissociation-products containing divalent carbon atoms. Thus benzalchloride gives tolane dichloride, *i.e.* :—

$$2C_6H_5 . CHCl_2 = 2C_6H_5 . CCl + HC_2$$
$$2C_6H_5 . CCl = C_6H_5C(Cl) = (Cl)C . C_6H_5$$

F. G. D.

676. *Soap Solutions.* **A. Smits.** (Zeitschr. Phys. Chem. 45. pp. 608–612, Nov. 24, 1903. Konink. Akad. Wetensch. Amsterdam, Versl. p. 112, June 30, 1900.)—By combining boiling-point and vapour-pressure determinations, the author finds that, in less concentrations than 1 gram-molecule per 1,000 grams of water, sodium palmitate causes an increase in the boiling-point and a lowering of the vapour pressure, both of which increase from the concentration zero to a maximum and then fall and vanish when the above concentration is reached. This behaviour is explained by the occurrence in dilute solutions of hydrolytic dissociation which does not take place at higher concentrations. Since a concentrated sodium palmitate solution possesses the same boiling-point and vapour pressure as pure water, such a solution must be a colloidal one. T. H. P.

677. *Velocity of Decomposition of Ammonium Nitrite.* II. **K. Arndt.** (Zeitschr. Phys. Chem. 45. pp. 571–583, Nov. 24, 1903.)—The author criticises the work of Blanchard [see Abstract No. 516 (1903)] and cannot confirm the rendering active of potassium permanganate by means of ammonium nitrite. The velocity of decomposition of ammonium nitrite is proportional to the concentration of the salt and to that of the free acid, and as the concentrations of the salt and acid are proportional, the reaction is of the second order with reference to the salt. The author tests the indirect method of determining the K of nitrous acid given by Schümann (Ber. 33. p. 527, 1900), who obtained the value 0·00044 at 25°, and finds the number 0·00040. In proportion to its concentration, acetic acid accelerates the decomposition of ammonium nitrite as strongly as does sulphuric or succinic acid. The action of an added nitrite depends, to a very great extent, on its purity. Potassium nitrite has a weaker action than the sodium salt and the latter than the barium one. On the supposition that it is the free nitrous acid which acts here, the degrees of hydrolytic dissociation of the various hydrates are calculated, these being, for 0·3 normal solutions, 0·1, 0·25, and 0·32 per cent. for the sodium, ammonium, and barium salts respectively. The actions of sodium and potassium nitrates on the velocity of decomposition can be calculated quantitively, if it is assumed that the non-dissociated and non-hydrolysed portion of the salt is inactive. [See also Abstract No. 126 (1902).] T. H. P.

678. *Formation of Complex Compounds in Mixtures of Acids.* **R. Hofmann.** (Zeitschr. Phys. Chem. 45. pp. 584–588, Nov. 24, 1903.)—Employing comparatively strong solutions of HCl, HBr, and H_2SO_4 (3–4 equivalent normal), the author finds that the law of isohydry holds good, *i.e.*, if two solutions of HBr and H_2SO_4 be found of such a strength that the conductivities of mixtures of either with one and the same hydrochloric acid solution can be calculated according to the simple (linear) law of mixtures, then this law also holds good for the conductivities of mixtures of these solutions of HBr and H_2SO_4. When, however, chromic acid enters into the combinations, the law of isohydry ceases to hold. The measurements show that HCl and H_2CrO_4 form complex compounds. F. G. D.

679. *Dynamics of the Reaction of Chlorine upon Benzol under the Influence of Light and Different Catalysers.* **A. Slator.** (Zeitschr. Phys. Chem. 45. pp. 513–556, Nov. 24, 1903. Journ. Chem. Soc. 83. 729, 1903.)—The reaction between chlorine and benzol in excess has been investigated under different circumstances either in benzol solution or carbon tetrachloride. The yields

depend entirely on the relative velocities of the reactions which take place. Under these circumstances the reaction proceeds according to the equations $C_6H_6 + Cl_2 = C_6H_5Cl + HCl$, and $C_6H_6 + 3Cl_2 = C_6H_6Cl_6$. The two reactions have been distinguished and measured by titrating for chlorine and hydrochloric acid. The velocity of the reaction without a catalyser is very small. With iodine chloride, addition and substitution take place approximately, $8C_6H_6 + 10Cl_2 = 7HCl + 7C_6H_5Cl + C_6H_6Cl_6$. With stannic and ferric chlorides, substitution only takes place; in the light, addition. The following equations express the influence of different conditions on the velocity :—

Catalyser.	Velocity. $d(Cl)/dt$	Temp. Coeff. $\frac{K_{t+10}}{K_t}$
I Cl	$K(Cl_2)(C_6H_6)(ICl)^2$	1·05
$SnCl_4$	$K(Cl_2)(SnCl_4)$	1·5
$FeCl_3$	$K(Cl_2)(FeCl_3)$	2·5
Light	$K(Cl_2)^2(C_6H_6)$	1·5

As regards the influence of light and the variation of the chlorine concentration, a new method has been worked out, enabling conditions of equal illuminations to be obtained in solutions of different density. The important part played by catalysers makes it probable that they actually take part in the reaction. The molecular weight of chlorine and iodine chloride in benzol was determined by the freezing-point method, which indicated the existence of Cl_2 and ICl. F. S.

680. *Condition of Sodium Sulphate in Solution.* **C. Marie** and **R. Marquis.** (Zeitschr. Phys. Chem. 45. pp. 566–570, Nov. 24, 1903.)—Crystals of Glauber's salt lose their water of crystallisation at 32·38° C.; if this is also the case in solution, the number of free water molecules should suddenly increase at this temperature, owing to the loss of $10H_2O$ from each molecule of the salt. The solubility of an indifferent salt in a concentrated solution of Glauber's salt should then give a curve with a break in continuity at the point of dehydration. The authors find that the solubility of sodium chloride in such a concentrated (not saturated) solution is represented by a continuous curve, and consequently there is no alteration in the solution which corresponds to the dehydration of the solid salt. The following table gives the observed solubilities of sodium chloride in a 7·45 per cent. solution of Na_2SO_4 :—

Temp. ° C.	14·8	17·9	24·85	25·60	27·75	32·18	34·28
Per cent. NaCl in solution...	23·30	23·33	23·45	23·48	23·52	23·55	23·68

T. S. P.

681. *Rate of Formation of Iodates in Alkaline Solutions of Iodine.* **E. L. C. Forster.** (Journ. Phys. Chem. 7. pp. 640–652, Dec., 1903.)—The author has investigated the effect of varying the concentrations of caustic potash, iodine, and potassium iodide on the rate of formation of potassium iodate in alkaline solutions of iodine. When the potash is present in large excess, giving colourless solutions, the results can be expressed with a fair degree of accuracy by assuming that the velocity is proportional to the concentration of the iodine ions I′, the hypoiodite ion OI′, and the hypoiodous acid HIO. The method used was to vary the concentrations of the potash, potassium iodide, and iodine respectively, and find the velocity of reaction by

determining from time to time the iodine still remaining untransformed into iodate. The constants of the second order are found to be fairly good; in the presence of a large excess of potash the hypoiodous acid can be neglected. It is then found that the velocity is directly proportional to the concentration of the I′ ions, and inversely proportional to that of the OH′ ions. Since the product of the H· and OH′ ions is constant, and since the concentration of the hypoiodous acid is proportional to the product of H· and IO′, it follows that the velocity is proportional to the concentrations of IO′, I′, and HIO. In brown solutions, where the iodine is in excess, the relations are more complex, and the laws which hold for colourless solutions are not valid. It was found that in the presence of a large excess of iodine, the velocity is increased by increasing the amount of the potash or iodine, and decreased by adding to that of the potassium iodide. On continually increasing the amount of the potash, so that the solution changes from brown to colourless, the velocity passes through a maximum. Velocities were determined at 0° C. and 30·3°, and the temperature coefficient found to be smaller than is customary. T. S. P.

682. *Negative Catalysis in Homogeneous Systems.* **A. Titoff.** (Zeitschr. Phys. Chem. 45. pp. 641–683, Dec. 15, 1903.)—Negative catalysis is the retarding action of small quantities of foreign substances on the velocity of chemical change, and is to be distinguished from those cases in which the retardation is due to the elimination of a positive catalyst already present, as in the "poisoning" of platinum black by arsenic, and the elimination of alkaline catalysts by the addition of acids. The case studied was the atmospheric oxidation of sodium sulphite, previously investigated by Bigelow. The rate of oxidation is very greatly influenced by the purity of the water, as is shown by the following table:—

Ordinary distilled water (iron still-head, tin receiver) ……	10–20	min.
Kahlbaum's distilled water (silver condenser)……………	200–300	„
Ordinary distilled water (tinned copper throughout) ……	150–250	„
„ „ „ (using Jena flasks)………………	150–270	„
„ „ „ (protected from CO_2) ……………	480–1500	„
Purest water available ………………………………	1500–1800	„

The times given are those required for the oxidation of half the sulphite by dissolved oxygen at 0° C., and the very rapid oxidation of the first samples is due to the iron still-head, ferrous chloride being a very powerful positive catalyst (carrier of oxygen). The change proceeds as a reaction of the first order, and within wide limits is independent of the concentration of the oxygen.

Copper salts have a very extraordinary catalytic action; a billionth normal ($N/10^{12}$) solution of copper sulphate increased the velocity in the ratio of 14 to 18, and by merely allowing the water used in the experiment to flow over a strip of bright copper, the velocity was nearly doubled, although the copper was in contact with the water for less than a minute; the acceleration produced by the copper salt is approximately proportional to the concentration. Mannitol has a very marked retarding action on the oxidation; the velocity was reduced to 50 per cent. of the normal by N/100000 mannitol, to 21 per cent. by N/50000 and to 14 per cent. by N/20000. In order to neutralise the positive catalytic action of copper sulphate it is necessary, however, to add 1,800 mols. of mannitol, and a number of observations were made on mixtures containing both larger and smaller proportions of mannitol. A powerful inorganic negative catalyst was found in stannic chloride, and the addition of this compound reduced the velocity to 25 per cent. of the normal when the concentration was only N/250000; the tin salt was thus 150–160 times as active as mannitol, but 20–25 times less active than the copper salt. Alkalies have a slight retarding action, four or five times feebler than that of mannitol; thus N/10000 NaOH reduced the velocity to about one-sixth, but N/1000 Na_2CO_3 only reduced the velocity to one-fifth. Potassium cyanide acts as an alkali and produces a greater retardation than mannitol; at a concentration of N/20000 it reduces the velocity of oxidation to 8 per cent. of the normal. Acids act in a curious manner; small quantities of CO_2 produce an acceleration which reaches a maximum at N/400 and then decreases again; HCl produces an acceleration which reaches a maximum at N/2000 and then decreases, until at N/140 the retardation is so great that the action is practically stopped. N/10000 HCl produces about the same acceleration as $N/(5 \times 10^7)$ $CuSO_4$, but the addition of N/50000 mannitol reduces the acceleration by the HCl to only a third of the value possessed by the copper solution after similar treatment. It is therefore concluded that the acceleration and retardation are specific properties of the catalysts and do not obey any simple additive law. T. M. L.

683. *Electrolysis with E.M.F.'s below Decomposition Values.* **S. L. Bigelow.** (Journ. Phys. Chem. 6. pp. 603–628, Dec., 1902.)—When an e.m.f. below the decomposition value is applied to an electrolytic cell a small current passes and can be maintained indefinitely. This Helmholtz explained by "electrolytic convection." The author's experiments are with a view to test this theory. Platinum electrodes in sulphuric acid were used. When a p.d. of about 1 volt was applied the current slowly fell, becoming steady after about 70 days. Shaking increases the current. Helmholtz found that the "residual current" was almost negligible when the electrolyte is freed from gases by being in vacuo; the author finds that the current diminishes much more rapidly than when the gases are not removed, but the final minimum values do not seem to differ very much. Increasing the strength of acid from *n*/200 to *n*/2 makes little difference. From this the author concludes that the current is not carried by the ions resulting from the dissociation of the acid, but by a form of ion hitherto unrecognised, and due to the dissolved gases. Temperature has a marked effect, the conductivity being doubled by a rise of 10° to 15°, which is much above the rate for acids. The author puts forward the theory that a gas in solution is analogous to a rarified gas, some of the molecules carrying charges. These would permit the residual current to pass until the decomposition point is reached, above which the current would be carried by the ions of the electrolyte. W. R. C.

684. *Isohydry as an Aid in Determining the Dissociation Relations of Ternary Electrolytes.* **G. Kümmell.** (Zeitschr. Elektrochem. 9. pp. 975–977, Dec. 17, 1903.)—In order to find the concentration and velocity of the separate ions (Mg, Cl, MgCl) in a concentrated solution of a ternary electrolyte of the type of $MgCl_2$, the author combines the determination of the conductivity and transference numbers with the principle of isohydry. He obtains, for example, isohydric solutions of potassium chloride, from which he takes the values for Cl. Knowing the mobilities of the Cl and Mg

ions, a simple calculation shows that the mobility of the MgCl ions is at most 23 (at 25°), while in a $n/10$ solution MgCl ions are no longer present. The author regards the absolute numbers of MgCl ions, found by means of the transference numbers of $MgCl_2$ determined by Hittorf, as of little importance, as there may, perhaps, be still more complex aggregates of ions in solution—the transference number reaches the theoretical value only with very high dilutions. The mean velocity of the MgCl ions lies between 0 and 10 (at 25°), and their concentrations are: about 0·8 in a 2 *n* solution, 0·45 in a 1·5 *n* solution, 0·2 in an *n* solution, and 0·05 in a 0·5 *n* solution. T. H. P.

685. *Reproducibility of the P.D.'s of some Oxidation-Electrodes.* **J. Scobai.** (Zeitschr. Elektrochem. 9. pp. 879–887, Nov. 5, 1903.)—An investigation of the constancy and reproducibility of certain oxidation-electrodes at which the potential-controlling reaction is due to a powerful oxidising-agent and practically irreversible. Platinum electrodes were employed, and the single p.d.'s measured by combining the oxidation-electrode, with a normal $Hg - Hg_2SO_4 - H_2SO_4$ electrode. When (equivalent) normal H_2SO_4 is employed, the p.d. of this normal electrode is 0·956 volt. The oxidising agents employed were MnO_2, $KMnO_4$, CrO_3, and sodium persulphate, in presence of 1/1, 12/1, 22/1, normal H_2SO_4. Concentrated H_2SO_4 was also used. Except in the case of sodium persulphate it was found that the p.d.'s were constant and reproducible, and therefore to be regarded as characteristic of the several oxidisers. F. G. D.

686. *Electrolysis of Alkaline Chlorides. Theory of Diaphragm Electrolysis.* **P. A. Guye.** (Archives des Sciences, 15. pp. 612–622, June; 16. pp. 393–416, Oct.; and pp. 652–668, Dec., 1903.)—I. The author shows that the apparently complex character of the electrolysis of the alkaline chlorides under the ordinary conditions of working becomes very much simplified by making use of the fundamental principle of Hittorf, viz., that the alkaline chloride and alkali participate simultaneously in the electrolysis. It thus becomes possible to calculate, with great exactitude, the quantity of alkali produced in any given electrolysis, provided that the transport factor of the alkali and its conductivity and that of the alkaline chloride have been previously determined. It is shown that the instantaneous current-yield is expressed very approximately by the relation: $r = 1 - nx$, where n is the transport number of the OH ions, and x the amount of alkali taking part in the electrolysis; the value of r at any particular temperature is therefore practically only a function of the alkali concentration c. If the concentration of the chloride in the kathode liquid is kept constant, the relation is: $r = 1/(1 + ac)^{\frac{1}{2}}$; whilst if the chloride in the kathode liquid is not replaced as it gradually disappears, the relation becomes: $r = 1/(1 + ac)$. The value of a is influenced but slightly by variations in the concentration or temperature. II. In diaphragm electrolysis, two methods of working are made use of—one in which the electrolysis is continued until the alkalinity of the kathode solution reaches a certain value, when the liquid is replaced by fresh; and the other, in which the concentration of the kathode solution is kept approximately constant by continuous feeding with chloride solution. The first of these methods is the most economical as regards the expenditure of electrical energy. Expressions are deduced, in the two separate cases, for the value of the concentration after the passage of a definite quantity of electricity. For the second method of procedure, two cases are considered: (*a*) When the added solution does

not mix with the remainder, and (*b*) when instantaneous and complete mixture takes place. Under condition (*a*) the current yield equals that of the first method of working. Neither of the two cases, (*a*) and (*b*), is actually met with in practice, but when the kathode compartment is large and the current density small, case (*a*) is approximated to, whilst when the kathode compartment is small, and the current density high (*b*) is closely realised. III. The author applies the principles developed in his two preceding papers to the case of two experiments carried out on a commercial scale by the "Volta" Company. The experimental results agree well with those calculated by the author, and the few slight discrepancies observed are in the direction that would be expected from the assumptions made in the author's calculations. T. H. P.

687. *Separation of Nickel from Zinc.* **Hollard** and **Bertiaux.** (Comptes Rendus, 137. pp. 853–855, Nov. 23, 1903.)—The authors refer to the difficulty of separating from each other (electrolytically) metals whose electromotive forces of polarisation are greater than that of hydrogen. This difficulty, which is caused by the production of hydrogen and oxygen at the electrodes of the cell, and the high resistance of the latter in consequence (Nernst), may be overcome by suppressing one or other of the gases. The most recent method and the best devised by the authors for separating nickel from zinc, in which the oxygen is caused to combine with SO_2 dissolved in the electrolyte, is as follows: To the nickel and zinc in the form of sulphates are added 10 gm. of ammonium sulphate, 5 gm. of magnesium sulphate, 5 c.cm. of saturated solution of SO_2, and finally excess of ammonia 25 c.cm. (sp. g. 0·924). The solution is then placed in a cell with platinum electrodes, after dilution to 300 c.cm., and electrolysed at a temperature never below 90° C. with a current of 0·1 amperes. The separation of the nickel should be practically complete after four hours, and after five hours the kathode may be removed. With 0·25 gm. of nickel and quantities of zinc varying from 0·05–1 gm., the worst estimation was 0·2517 gm. of nickel; and with 0·1 gm. of nickel and from 0·1–1 gm. of zinc the worst estimation was 0·0963 gm. of nickel. [See also Abstracts Nos. 1512 (1903) and 455 (1904).] J. D. C.

688. *Behaviour of Red Colloidal Gold Solutions towards the Electric Current and towards Electrolytes.* **J. C. Blake.** (Amer. Journ. Sci. 16. pp. 433–441, Dec., 1903.)—The gold solutions employed in the author's experiments were prepared by the action of an ethereal solution of gold chloride on acetylene water containing ether. When subjected, in an ordinary beaker, to a potential difference of 110 volts by means of gold or platinum electrodes, such a solution undergoes no change. But if a U-tube is employed the restricted diffusion brings about an electric migration and concentration of the gold; the kathode liquid becomes colourless and the anode solution first darker and then lighter in colour, while in the bend of the U-tube all the gold concentrates in the form of a red cloud which, with water, gives red colloidal gold solution again. As regards the influence of electrolytes on colloidal gold solutions, five effects must be distinguished: (1) Coagulation and (2) Precipitation of red gold solutions; (3) Coagulation and (4) Precipitation of blue gold solutions; (5) Transformation of red into blue gold solutions. A number of electrolytes were examined as to their power of bringing about this last change, a gold solution containing 0·044 gram per litre being titrated with electrolyte solutions until the colour suddenly changes; the time-factor is of little importance, since the titration can be carried out in from 2 to 5

minutes, while the subsequent complete precipitation occupies a longer time. The results confirm Whetham's hypothesis that the activity of electrolytes towards colloidal solutions is an exponential function of the valency of the basic elements which they contain, the final concentration of sodium chloride necessary to induce the change of colour from red to blue being 22·4 times that of barium chloride, which is 14·5 times that of potassium alum. The action of a mixture of two electrolytes with different basic constituents is more subtractive than additive in nature. A solution saturated with ether requires a larger addition of electrolyte than one containing only a little ether. If while the titration is being carried out electrodes at a potential difference of 110 volts are placed in the liquid, the end-point is displaced; the activity of alum is raised while that of sodium sulphate falls. If the titration is continued until a violet colour appears the gold is not deposited slowly in the form of a violet powder, but rapidly and completely as a blue powder. [See also Abstract No. 660 (1904).] T. H. P.

689. *Electrolytic Reduction of Nitrate into Nitrite.* **E. Müller** and **J. Weber.** (Zeitschr. Elektrochem. 9. pp. 955–967, Dec. 10, 1903. From the Electrochemical Laboratory of the Königl. Sächs. Technischen Hochschule in Dresden.)—The author's first experiments, in which the kathode potential, the soluble and gaseous reduction products, &c., were measured, showed that with smooth platinum electrodes nitrite is more strongly depolarised than nitrate and considerable quantities of ammonia, but no hydroxylamine, are formed during the electrolysis. Smooth copper electrodes give less concordant results, whilst spongy copper electrodes always yield comparable values and high yields of nitrite; in this case the nitrate is at first more strongly depolarised than an equivalent solution of nitrite, and scarcely any ammonia is formed if the kathode potential be kept at a low value, which may be done by momentarily polarising the kathode from time to time by converting it into the anode. If the kathode potential with respect to a decinormal electrode always remains less than 1 volt, and if only 2/3 of the nitrate is electrolysed, a 20 per cent. nitrate solution gives a 10 per cent. nitrite solution, the current yield being about 90 per cent. Since the nitrate cannot be used up to a greater extent than this, and since also small current densities—about 0·007 ampere per sq. cm.—must be employed, the process can scarcely be applied practically. The authors discuss the causes of the great differences in the behaviour of the different kathodes, and conclude that in the copper a catalytic substance is present, which occurs in much smaller quantity or not at all in the platinum, and that it is this substance to which the copper owes its property of reducing the nitrate to a greater extent, and the nitrite to a less extent, than the platinum. This conclusion is verified experimentally by shaking up alkaline and neutral solutions of sodium nitrite with spongy copper. T. H. P.

REFERENCE.

690. *Application of the Nernst Lamp Formula to a Mixture of Two Solvents.* **G. Timofeeff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 6a. pp. 646–649, 1903.)—The author applies the Nernst formula to the case of a mixture of two solvents, the theoretical deductions being applied with satisfactory results to some experiments on $CH_3COOH - H_2O$, $H_2O, CH_3COOH - C_6H_6$, and CH_3COOH. A. G